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Taxonomic revision of the genera *Tamphana* Schaus and *Tuyvae* Orlandin, Piovesan & Carneiro with description of eleven new species (Lepidoptera, Apatelodidae)

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Tuyvae;
taxonomy;
description;
new species;
biodiversity;
Neotropical;
Brazil;
Colombia;
Costa Rica;
Ecuador;
French Guiana;
Panama;
Peru.

Abstract. – The genus *Tamphana* Schaus, 1892 is revised. The transfer of *Tamphana* from Bombycidae to Apatelodidae is confirmed. The study, based on examination of habitus, genitalia, and barcoding, leads to the separation of the various species currently placed within *Tamphana* into two distinct genera. Examination of genitalia of specimens supposedly belonging to the species *T. marmorea* Schaus, 1892 revealed strikingly different characters leading to description of nine new species: *T. awa* **n. sp.** from Maranhão, Brazil, *T. ampliata* **n. sp.** from Costa Rica, Panama, Venezuela and Ecuador, *T. picobonitensis* **n. sp.** from Honduras and Costa Rica, *T. furtadoi* **n. sp.** from Mato Grosso, Brazil, *T. lauriei* **n. sp.** from Belize, *T. lucifer* **n. sp.** from French Guiana, *T. paranensis* **n. sp.** from Brazil (Minas Gerais and Paraná), *T. tikuna* **n. sp.** from Colombia, Peru and Brazil (Amazonas), *T. tripertita* **n. sp.** from French Guiana. The adults and genitalia of all the new species are figured. A lectotype for *Tamphana marmorea* is here designated and figured. In the genus *Tuyvae* Orlandin, Piovesan & Carneiro, 2024, recently published, to the two already described species: *Tuyvae maoma* (Schaus, 1920) and *Tuyvae orion* (Dognin, 1916), two additional new species are described: *Tuyvae douglasboyesi* **n. sp.** from Colombia and *Tuyvae carabaya* **n. sp.** from Peru. A lectotype for *Tuyvae orion* is here designated and figured.

Herbin D., Giusti A. & Mielke C. G. C., 2024. – Taxonomic revision of the genera *Tamphana* Schaus and *Tuyvae* Orlandin, Piovesan & Carneiro with description of eleven new species (Lepidoptera, Apatelodidae). *Faunitaxys*, 12(61): 1 – 31.

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Introduction

Tamphana Schaus, 1892 was erected to accommodate a single species, *T. marmorea* Schaus, 1892 which he placed within the family Bombycidae. Schaus *in* Seitz (1929) following his previous classification, added it to the subfamily Epiinae.

Minet (1994) expanded the Bombycidae family classification to include four subfamilies: Bombycinae (with tribes Bombycini and Epiini), Prismostictinae, Phiditiinae and Apatelodinae. In the same work, the genera *Arotros* Schaus, 1892 and *Tamphana* were transferred from Epiinae to Apatelodinae.

Tamphana was listed in Apatelodidae, Epiinae by Becker (1996), in disagreement with Minet (1994).

Regier *et al.* (2008) tested the classification by Minet (1994) based on sampling of five nuclear genes sampling and proposed a phylogenetic analysis. Complementary work by Zwick (2008) and Zwick *et al.* (2011) based on sampling 20 genes further revised Minet's classification, revealing Apatelodidae and Phiditiidae as distinct families from Bombycidae. However, *Tamphana* was not specifically addressed.

In the global checklist of the Bombycoidea, Kitching *et al.* (2018) listed *Tamphana* within Bombycidae, Epiinae.

Hamilton *et al.* (2019) demonstrated that the genus *Arotros* belonged to Apatelodidae rather than to Bombycidae, confirming Minet´s (1994) act, but again, the case of *Tamphana* was not specifically addressed.

Finally, Orlandin *et al.* (2024) followed Minet´s (1994) classification and transferred *Tamphana* to Apatelodidae.

Based on examination of *Tamphana* specimens from various localities in Central America, including Mexico, Belize, Honduras, Costa Rica and Panama, others in the Amazon basin in Colombia, Peru, French Guiana, and still others in the Andeans slopes of Colombia and Ecuador, in many collections, several cryptic species were identified and are described below.

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The genus *Tuyvae* Orlandin, Piovesan & Carneiro, 2024, erected to accommodate *T. orion* (Dognin, 1916; type species by original designation) and *T. maoma* (Schaus, 1920), originally included within *Tamphana*, is revised and two species are described as new.
The two main basic tools used were DNA barcoding (COI gene) within BOLD project and examination of genitalia, both methods providing coherent outputs.

Material and methods

Specimen photographs were taken with a Nikon D7000 and macro flash Nikon R1C1. A colour reference is included with each photograph, based on samples cut from the "RAL K5 semi matt classic". This sample includes the following colours:

Jet Black = RAL 9005 = RGB (3, 5, 10)
Signal Red = RAL 3001 = RGB (163, 23, 26)
Signal Green = RAL 6032 = RGB (41, 138, 64)
Signal Blue = RAL 5005 = RGB (0, 46, 122)
Dusty Grey = RAL 7037 = RGB (125, 125, 128)
Signal White = RAL 9003 = RGB (255, 255, 255)

The photographs were post-processed with Photoshop CS4 for levels and colour curves, to ensure (255,255,255) for the white, (0,0,0) for the black, and (125,125,125) for the grey. Then, it was verified by sampling in Photoshop CS4 that the other colour samples (red, green, blue) all gave RGB values close to those targeted ones, as listed above.
In the following descriptions, the colours are named in accordance with the RAL K5 reference. The following Internet link was used for equivalence RGB to RAL: http://rgb.to/.
A majority of described species were subjected to DNA analysis using short sequences corresponding to the barcode region of the COI mitochondrial gene via BOLD (Barcode of Life Data System, www.boldsystems.org) (Ratnasingham & Hebert, 2007). The sequences were aligned with the BOLD provided tools (BOLD Aligner: Amino Acid Based HMM), then exported in fasta format. Alignment was then performed with Muscle in Mega6 (Tamura *et al.*, 2013).
The genitalia were extracted by processing cut abdomens with hot KOH. Photographs of genitalia in CDH were taken under an Amscope trinocular with an associated 10 MP camera, then postprocessed with Photoshop CS4 by stacking of multiple images, and improved for sharpness and contrast.
The nomenclature of the genitalia follows Kristensen (2003). Distribution maps were constructed with Simplemappr (Shorthouse 2010).
Labels of primary types are given verbatim and separated by n-dashes.

Abbreviations

BSC: Personal collection of J. Bolling Sullivan, USA.
CBH: Personal collection of Bernard Hermier, Rémire-Montjoly, French Guiana.
CDH: Personal collection of Daniel Herbin, Garidech, France.
CGCM: Personal collection of Carlos G. C. Mielke, Curitiba, Paraná, Brazil.
CLAM: Personal collection of Alfred Moser, São Leopoldo, Rio Grande do Sul, Brazil.
DZUP: Coll. Padre Jesus S. Moure, Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Paraná, Brazil.
IAVH: Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, Bogota, Colombia.
MfNB: Museum für Naturkunde, Humboldt-Universtät, Berlin, Germany.
MNHN: Muséum National d'Histoire Naturelle, Paris, France.
NHMUK: Natural History Museum, London, United Kingdom.
USNM: National Museum of Natural History [formerly United States National Museum], Washington DC, USA.

Results and discussion

Tamphana Schaus, 1892

Type Species. – *Tamphana marmorea* Schaus, 1892: 325 (Lectotype designated hereafter)

Diagnosis. – *Tamphana* shows no external resemblance to any other known Apatelodidae genus. Small sized moths, with subtriangular forewings, male antennae bipectinate to the tip, female antennae filiform, brown to red brown ground colour with presence or absence of ivory patches at apex along costa, ventral side of abdomen ivory, legs with thick vestiture. Tibial spurs formula 0-2-2, while all the other Apatelodidae genera show 0-2-4, see Minet, 1994. Frenulum present, well developed. Venation shows only three Rs veins, hypothesis being that Rs1 and Rs2 are stalked. M2 equidistant from M1 and M3.
Male genitalia are characterized by almost absent, membranous or weakly sclerotized uncus, with on each side a distad structure longer than the uncus (socii) with often differentiated setae. Aedeagus is fused to fultura inferior, hardly detached without damaging the fultura.

Redescription

Male

Head. – Antennae bipectinate to the tip.

Legs (Fig. 1). – Prothoracic coxa thick, approximately half length of femur, epiphysis half length of the tibia. Mesothoracic and metathoracic legs with two tibial spurs: tibial spurs formula 0-2-2.

Forewing upperside. – Subtriangular, of relatively small size: 10 to 16 mm length, termen regularly convex. Ground colour brown, either uniform or marbled with ivory patches, particularly near apex. Small ivory dot at upper end of discal cell sometimes present, single or double. Antemedial and postmedial lines either absent or barely visible.

Forewing underside. – Uniform colour, paler than upperside, with indiscernible lines, but a subtle silhouette of ivory patches present.

Hindwing upperside. – Uniform brown colour, a patch of long and thick scales at mid length of anal margin, in rest position, protruding upwards, as illustrated in Fig. 7, 17 and 21.

Hindwing underside. – Uniform paler beige colour with a pair of darker lines.

Venation (Fig. 2). – Characteristic of Apatelodidae, very similar to *Apatelodes torrefacta* (J. E. Smith, 1797) as figured by Franclemont (1973: fig. 3a) but with small differences: M2 almost equidistant from M1 and M3 on forewing, slightly closer to M1 on hindwing. Only three Rs are found, Rs1 and Rs2 being interpreted as being fused together.

Abdomen. – Abdomen thin, longer than wings and generally with an anal tuft shaped as a W (see the photographs of live specimens in figures 17 and 21).

Genitalia. – Uncus either membranous or reduced and weakly sclerotized. A pair of well developed socii, and often with long differentiated setae. Valvae elongate, with rounded apex. Aedeagus generally diagnostic, mostly as long as the genital structure or considerably shorter, the apex sclerotized, with various apical structures: either single strong, multiple or three cornuti.

Female. – Slightly larger than male, habitus similar to male except for the termen of forewing: apex more acute, termen concave from apex to a central protruding tooth, then again concave from this tooth to tornus. In contrast with other Apatelodidae, antennae filiform.

Immature stages. – In the BOLD database public records, a caterpillar record from Mexico, Campeche, Calakmul (https://v4.boldsystems.org/index.php/Public_RecordView?processid=CQR292-13) shows a divergence of 1.2 to 1.3 % from *Tamphana* specimens barcoded from Costa Rica and Panama. This leaves no doubt that this must be a *Tamphana* caterpillar. It is covered with long white setae, typical for Apatelodidae caterpillars, whereas Epiinae caterpillars are not setose, thereby corroborating the placement of *Tamphana* in Apatelodidae.

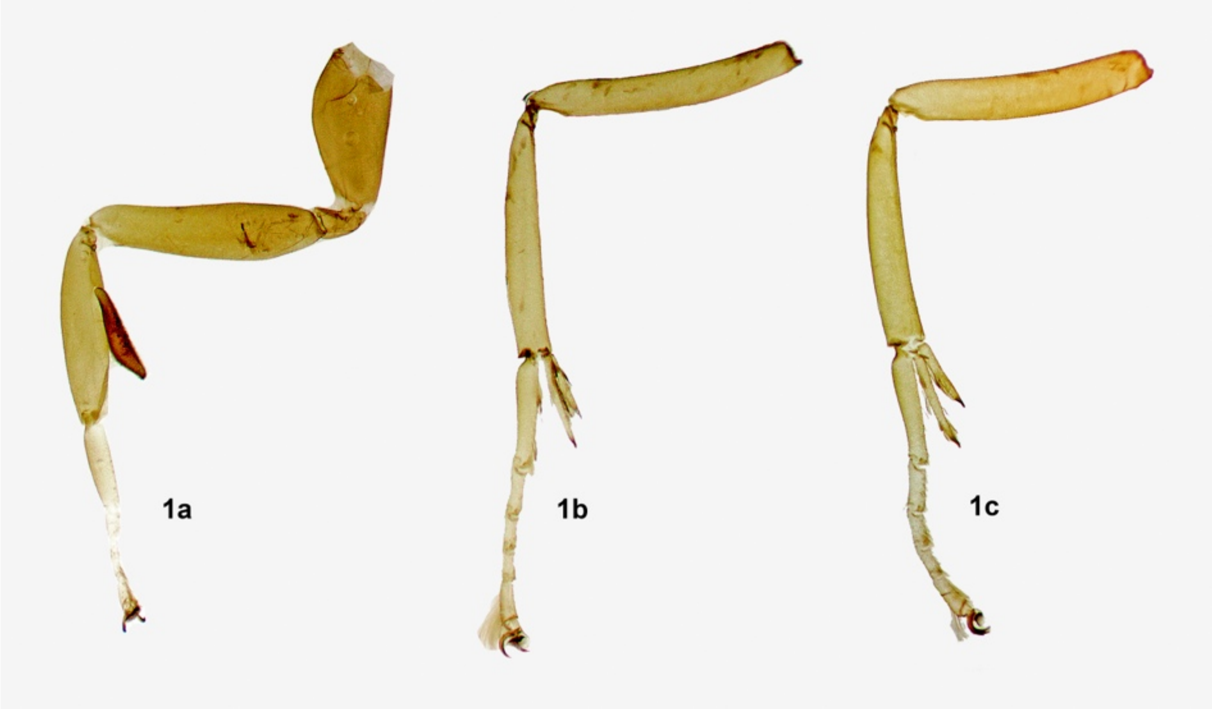


Fig. **1**. *Tamphana tripertita* **n**. **sp**. legs (based on a male *Tamphana* from French Guiana). **a**. Prothoracic leg. **b**. Mesothoracic leg. **c**. Metathoracic leg.

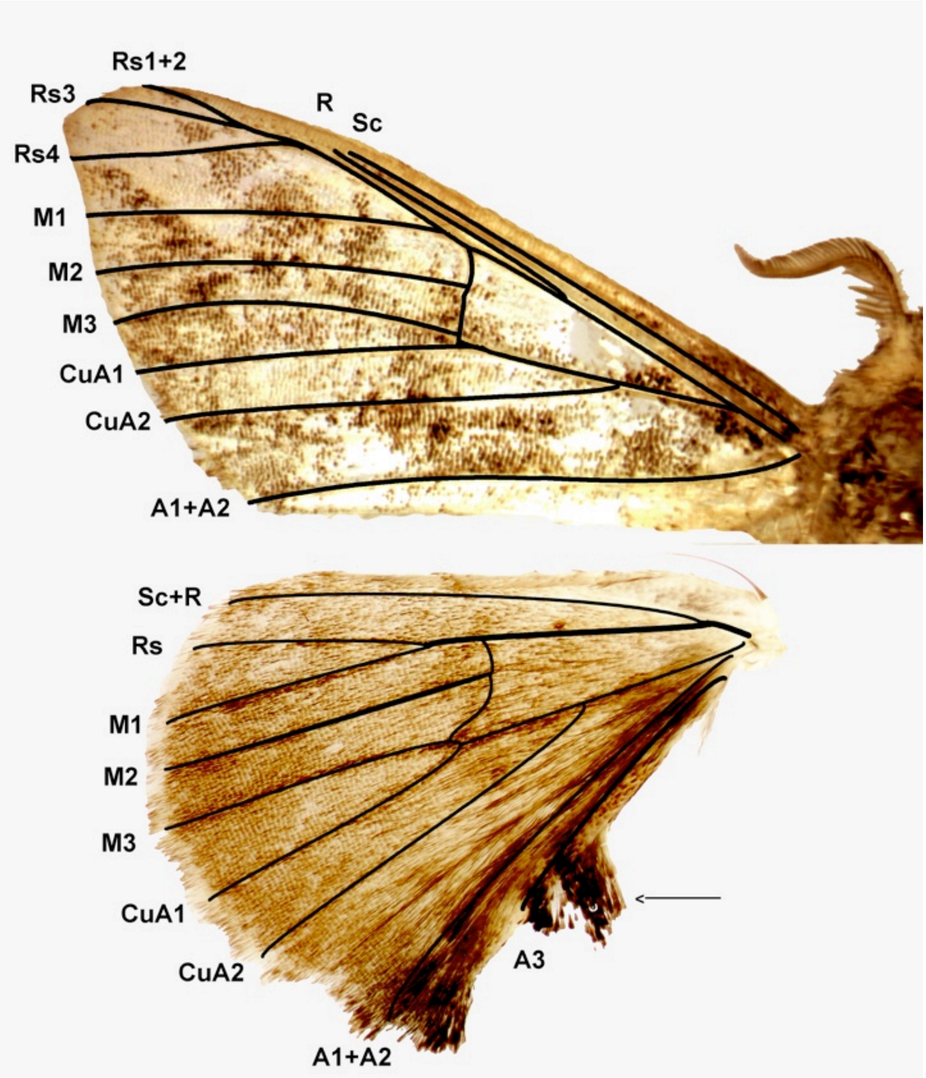


Fig. **2**. *Tamphana* venation based on a male of *Tamphana tripertita* **n**. **sp**. from French Guiana. The arrow points to a patch of long scales that, at rest position, is directed upwards above the body, and appears characteristic of *Tamphana*.

Discussion. – Based on the venation and the long setae of the caterpillars, the placement of *Tamphana* in Bombycidae, Epiinae is rejected, and the transfer to Apatelodidae, as already proposed by Minet (1994), is confirmed.
Within Apatelodidae, *Tamphana* is unusual by having the tibial spurs configuration: 0-2-2, where other Apatelodidae genera show 0-2-4. (Minet, 1994).

Based on male genitalia morphology when examined, otherwise imago characters, the species can be arranged into five species-groups:

a) ***marmorea*** species-group

Uncus undifferentiated. Socii digitiform, with or without setae. Valvae oval, elongated, covered in setae, and with basal sclerotized projections. Saccus with central sclerotized projection. Aedeagus long, more or less curved and with an apical sclerotized spine or teeth.
Genitalia of *T. lojanara* not examined, but the similarity of imagos habitus to *T. marmorea* and south American geographical origin lead provisionally to include this species in the *marmorea* species-group.
Included species: *T. awa* **n. sp.**, *T. furtadoi* **n. sp.**, *T. marmorea*, *T. tikuna* **n. sp.**, *T. tripertita* **n. sp.**, *T. lojanara.*

b) ***ampliata*** species-group

Genitalia structure heavily sclerotized and of overall spherical shape. Uncus a broad semicircle, enclosed within a hemispherical tegumen. Tegumen with a pair of strongly sclerotized, V-shaped, ventral projections. Valvae greatly reduced to a pair of small, pendulous structures beneath the tegumen. Saccus elongated, triangular and not sclerotized.
Included species: *T. ampliata* **n. sp.**, *T. lauriei* **n. sp.**, *T. picobonitensis* **n. sp.**

c) ***praecipua*** species-group

Genitalia of *T. praecipua* only examined: Apex of valvae with a double spiny process, a third spiny process on costa. Uncus membranous with two sclerotized socii. Aedeagus short, curved without cornuti.
Genitalia of *T. inferna* not examined. Imago with subtriangular wing, homogeneous fawn brown, slightly darker along costa, a tiny whitish spot at upper end of discal cell, no clearly visible lines.
Based on extreme similarity of imagos habitus and geographical origin of these two species, they are provisionally considered to be part of the same species group.
Included species: *T. praecipua*, *T. inferna*.

d) ***lucifer*** species-group

Genitalia with a short uncus bent at 90°, and bordered on each side by a socius twice as long as uncus with long differentiated setae. Valvae long and oval. Aedeagus short, with one cornutus.
Included species: *T. lucifer* **n. sp.**

e) ***paranensis*** species-group

Genitalia with wide, rectangular uncus with pointed sclerotized socii. Valvae oval with a spiny dorsal process and a second tiny triangular process below. Aedeagus long, slightly curved.
Included species: *T. paranensis* **n. sp.**

Key to species of *Tamphana* (males)

1. Marbled colour of forewing with an ivory patch at apex along costa **2**
— Homogenous brown colour of fore- and hindwing, no ivory patch at apex **8**

2. Single discocellular spot **3**
— Double discocellular spot ..... ***T. lojanara***

3. Socii projecting posteriorly and with long differentiated setae (origin South America) **4**
— Socii projecting posteriorly without differentiated setae **6**
— Socii projecting ventrally (origin Central America and Pacific Coast of South America) **7**

4. Aedeagus with apex with multiple spines (origin: Brazil, Cerrado biome) ..... ***T. furtadoi* n. sp.**
— Aedeagus with a single apical acute termination **5**

5. Saccus with a central ventral triangular projection (origin S.E. Brazil) ..... ***T. marmorea***
— Saccus with rounded, less acute central ventral projection (origin NE Brazil) ..... ***T. awa* n. sp.**

6. Aedeagus straight, long and narrow, with a trifid termination ..... ***T. tripertita* n. sp.**
— Aedeagus curved, long, narrow, sclerotized termination with minute teeth ..... ***T. tikuna* n. sp.**

7. Aedeagus with apex long, curved, proboscis-like (Ecuador, Panama,Venezuela) ..... ***T. ampliata* n. sp.**
— Aedeagus with apex short, acute and straight ..... ***T. picobonitensis* n. sp.**
— Aedeagus with apex slim, long, slightly curved and acute (Belize) ..... ***T. lauriei* n. sp.**

8. Dark chocolate brown patch near apex ..... ***T. paranensis* n. sp.**
— No dark chocolate patch near apex **9**

9. Forewing without spot at upper cell extremity ..... ***T. praecipua***
— Forewing with a spot at upper cell extremity **10**

10. No brown patch in forewing basal area, small white spot at cell extremity ..... ***T. inferna***
— Brown patch in forewing basal area, tiny brown spot at cell extremity ..... ***T. lucifer* n. sp.**

Tamphana marmorea **species-group**

Tamphana marmorea Schaus, 1892

(Fig. 3a, 3b, 4a, 4b & 4c)

Tamphana marmorea Schaus, 1892: 325
Tamphana marmorea; Schaus (1929: 692)
Tamphana marmorea; Becker (1996: 16)
Tamphana marmorea; Kitching *et al*. (2018: suppl. material 1)

Diagnosis. – The imagos of all species in the *marmorea* and *ampliata* species-groups look very similar, and morphologically the only way to identify them is by examining the male genitalia. Forewings with a marbled appearance, and with a triangular paler patch at apex. An area of darker scales marks the middle of the triangular patch. Discal cell of forewings with whitish spot at upper extremity. Hindwings brown beige and mostly unadorned apart from an area of darker elongated scales on anal margin. Uncus obscure, socii bearing multiple long setae. Valvae oval, elongated, reaching the base of the socii. Basal projections of the valvae thick and rounded. Aedeagus curved, 6x longer than wide and as long as the valva, ending in a strong pointed spine covered with tiny teeth.

Lectotype ♂ (**here designated**), Brazil, Rio de Janeiro, Palm[eiras], bearing the following labels: *Tamphana marmorea* type Schs – Palm. – Type n° 11477 U.S.N.M. – Collection WmSchaus. *In* USNM (examined).

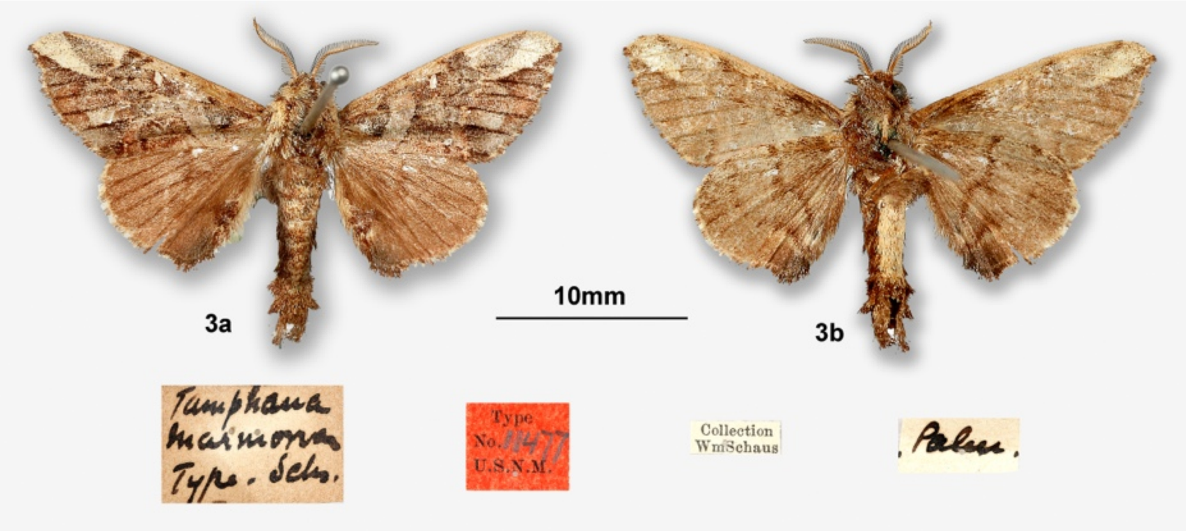
Redescription

Male (Fig. 3a & 3b)

Forewing length: 13 mm; wingspan: 27 mm.

Antennae bipectinate to the tip. Thorax brown beige (161,132,95) with paler beige tegulae. Legs with thick vestiture. Abdomen upperside proximal half beige (205,179,137), distal part half darker pearl gold (129,89,52). Abdomen underside ivory. Abdomen ending with a double V shaped anal tuft. Forewing upperside with an overall marbled appearance. Ground colour beige brown (175,125,80), double brown antemedial lines, area between lines paler beige (184,156,121). A whitish spot at upper extremity of discal cell. Triangular ivory patch from apex to M2. Small rectangular ivory patch between CuA1 and CuA2. Veins darker brown than background. Hindwing upperside uniform brown beige (178,132,88), unornamented, with a small indentation in termen between CuA2 and A1+A2, a patch of long scales on anal margin, veins darker brown than background.

Forewing underside homogeneous beige (185,159,117), basally darker nut brown (91,48,18). An ivory patch between apex and M2. Veins darker than background, absence of lines. Hindwing underside uniform brown beige,



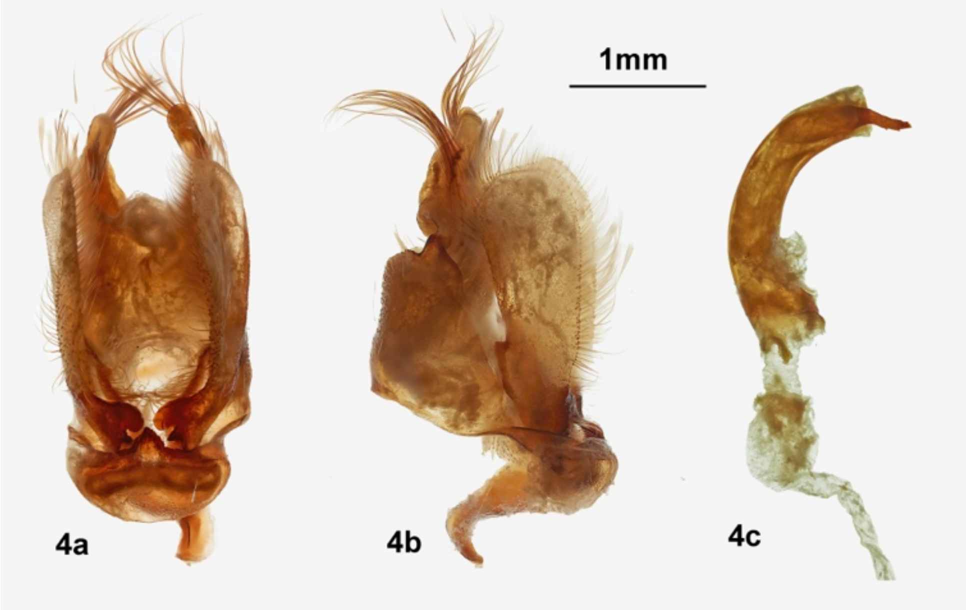


Fig. 3-4. *Tamphana marmorea* lectotype ♂.

3. **a**. Upperside. **b**. Underside (labels not to scale) (photos D. Herbin, courtesy USNM). **4**. Genitalia (prep. and photographs courtesy R. St Laurent, USNM). **a**. Ventral view. **b**. Lateral view. **c**. Aedeagus.

darker brown at tornus, with darker brown wavy medial and antemedial lines, and veins darker than background.

Genitalia (Fig. 4a, 4b & 4c). Uncus unidentified, socii digitiform with rounded apex and with long differentiated setae (half length of valva). Aedeagus cylindrical and curved with an acute apex like a strong single spine with few tiny teeth. Saccus with a meso-ventral projection, acute and triangular. Base of valvae with a thick rounded interior projection.

Female. – Unknown.

Discussion. – The derivation of the species epithet *marmorea* was not given by Schaus, but probably refers to the marbled appearance of the species. In the original description, Schaus (1892) provided more information about the type locality: Palmeiras, Rio de Janeiro. This locality corresponds to the foot of Corcovado in downtown Rio de Janeiro. The number of syntypes is not mentioned. Therefore, to stabilize the nomenclature, we designate a syntype specimen from Palmeiras Rio de Janeiro with the red label "Type n° 11477 USNM" as the lectotype.

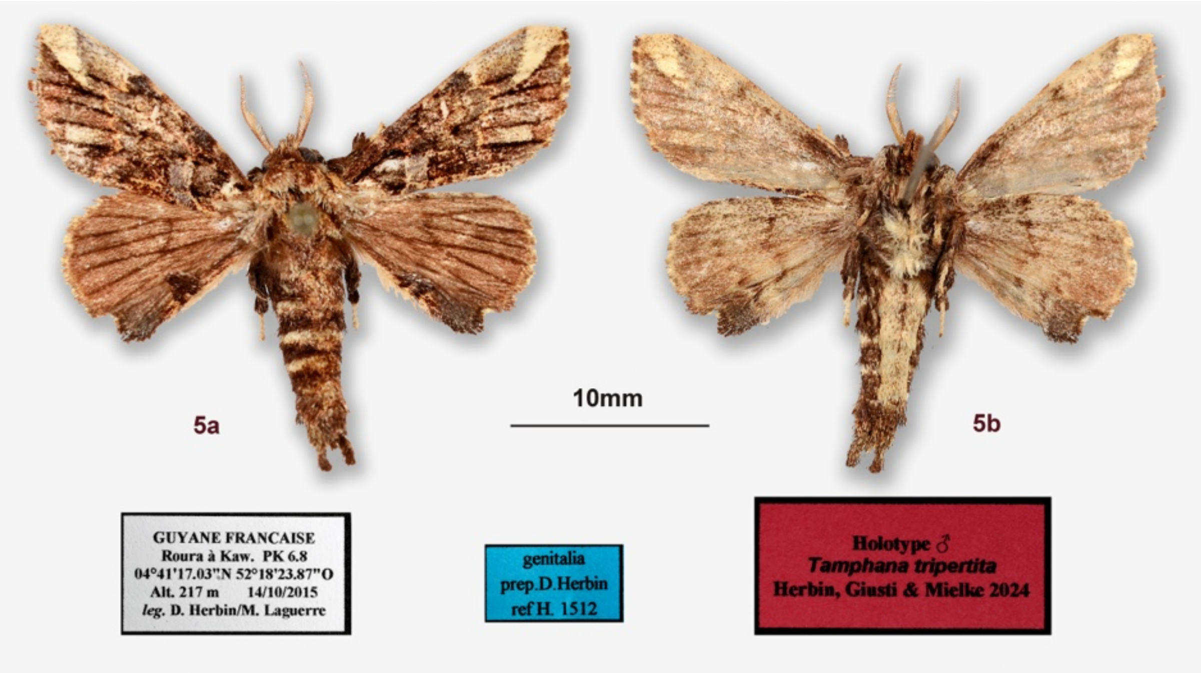
Schaus in Seitz (1929) mentioned specimens from Panama and Brazil (Amazonas, São Paulo de Olivença) as *T. marmorea*. The first likely refers to be *T. ampliata* **n. sp.**, and the second to *T. tikuna* **n. sp.**

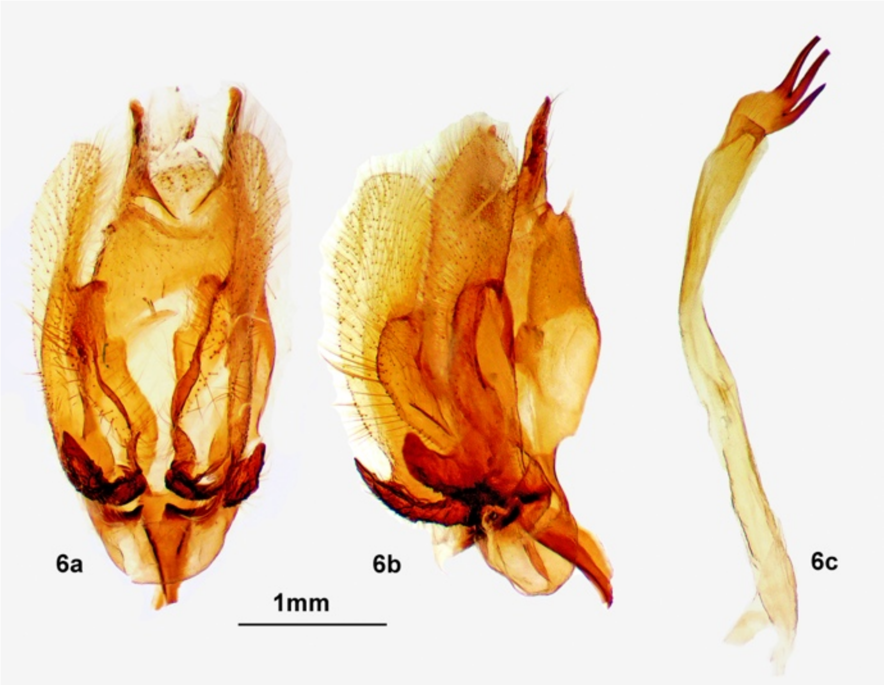
Tamphana tripertita Herbin, Giusti & Mielke **n. sp.**

(Fig. 5a, 5b, 6a, 6b, 6c & 7)

ZooBank : https://zoobank.org/76EEF658-919E-4C78-A2E1-960E79705A02

Diagnosis. – Externally similar to *T. marmorea*. Diagnostic characters are found in the male genitalia: aedeagus thin,





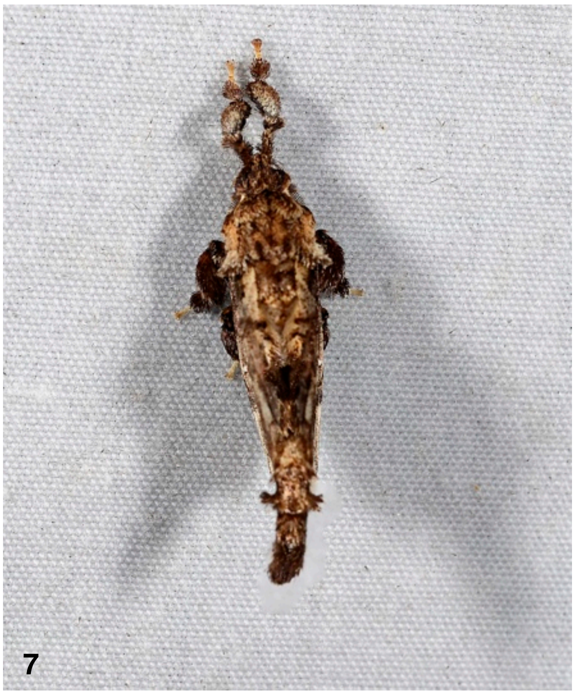


Fig. 5-7. *Tamphana tripertita* **n. sp.**

5-6. Holotype ♂. **5**. **a**. Upperside. **b**. Underside. **6**. Genitalia (H.1512). **a**. Ventral view. **b**. Lateral view. **c**. Aedeagus. **7**. Resting position with prothoracic legs extended. Note the tuft of long scales protruding from the anal margin of the hindwings, which helps the moth resemble a small piece of wood (photo D. Herbin in F. Guiana).

cylindrical (20x longer than wide) and longer than the genitalia structure (4 mm vs 3.3 mm), with a trifid apex. In addition, differentiated setae are absent from the socii whereas these are present in *T. marmorea*.

Holotype, ♂, bearing the following labels: Holotype ♂, *Tamphana tripertita* Herbin, Giusti & Mielke 2024 – Guyane Française [French Guiana], Roura à Kaw, PK 6.8, 04°41'17.03"N 52°18'23.87"O, Alt. 217m 14.10[Oct.].2015, *leg.* D. Herbin/M. Laguerre – Genitalia prep. D. Herbin ref H. 1512. *In* MNHN.

Paratypes (30 ♂)

- **2** ♂, French Guiana, Piste Coralie, 4°29'46.65"N 52°23'52.28"W, 68 m, 6.X.2013, *leg.* D. Herbin. *In* CDH.
- **2** ♂, French Guiana, Piste Patagai/Counamama, 5°20'34.23"N 53°12'47.86"W, 58 m, 9.X.2013, *leg.* D. Herbin. *In* CDH.
- **3** ♂, French Guiana, Piste Patagai/Counamama, 4°34'37.27"N 52°14'09.55"W, 268 m, 24.X.2013, *leg.* O. Felis. *In* CDH.
- **1** ♂, French Guiana, Piste Patagai/Counamama, 5°23'56.69"N 53°11'21.91"W, 47 m, 21.XI.2013, *leg.* D. Herbin. *In* CDH.
- **1** ♂, French Guiana, Route de Kaw, 4°34'37.27"N 52°14'09.55"W, 268 m, 24.XI.2013, *leg.* D. Herbin. *In* CDH.
- **1** ♂, French Guiana, Piste Patagai/Counamama,5°20'34.23"N 53°12'47.86"W, 58 m, 4.XII.2013, *leg.*D. Herbin – Genitalia prep. D. Herbin ref H. 1507. *In* CDH.
- **1** ♂, French Guiana, Maripasoula, Crique Alama (DZ), 2°14'01"N 54°26'59"W, 330 m, 11-24.III.2014, *leg.* J. Barbut. *In* CDH.
- **2** ♂, French Guiana, Piste Patagai/Counamama, 5°23'59.09"N 53°11'23.30"W, 45 m, 16.X.2015, *leg.*D. Herbin. *In* CDH.
- **3** ♂, French Guiana, Grand Santi, 4°17'5.1"N 54°21'6.7"W, 109 m, 14-18.X.2017, *leg.* B. Vincent & J. Barbut – Genitalia prep. D. Herbin ref H. 1507. *In* CDH.
- **1** ♂, French Guiana, Parcelles CIRAD de Combi, plantations expérimentales pk1, 5°18'N 52°55'30"W, 4.II.2011, *leg.* B. Hermier, n° 24201. *In* CBH.
- **1** ♂, French Guiana, D6 pk3, 4°32'30"N 52°8'30"W, 5.IV.2000, *leg.* B. Hermier, n° 17908. *In* CBH.
- **1** ♂, French Guiana, Route forestière de Coralie pk2, 4°30'30"N 52°22'30"W, 19.IV.1996, *leg.* B. Hermier, n° 9873. *In* CBH.
- **1** ♂, French Guiana, Route d'Apatou pk25.5 spk2+4.4, 1.X.2011, *leg.* B. Hermier, n° 24965. *In* CBH.
- **1** ♂, French Guiana, Route forestière de Changement Coralie Est pk2.2, 4.X.2000, *leg.* B. Hermier, n° 19065. *In* CBH.
- **1** ♂, French Guiana, Route forestière de la Roche Florian pk3, 5°28'30"N 53°32'W, 17.X.1995, *leg.* B. Hermier, n° 8092. *In* CBH.
- **1** ♂, French Guiana, Piste Régina, St Georges pk4.5, 4°15'N 52°7'30"W, 28.X.1995, *leg.* B. Hermier, n° 9776. *In* CBH.
- **1** ♂, French Guiana, Route forestière de Saut Léodate pk18, entrée de la piste Christine, 4°53'N 52°37'W, 4.XI.1997, *leg.* B. Hermier, n° 13572. *In* CBH.
- **1** ♂, French Guiana, Parcelles CIRAD de Combi, plantations expérimentales pk1,8, 5°18'N 52°55'30"W, 5.XI.2010, *leg.* B. Hermier, n° 23897. *In* CBH.
- **2** ♂, French Guiana, Regina, RN2 pk136+2+3 Piste forestière, 17 XI 2007, *leg.* F. Bénéluz, Hermier, n° 23067 et 23068. *In* CBH.
- **1** ♂, French Guiana, N2 pk41, 4°38'N 53°22'W, 5.XII.1997, *leg.* B. Hermier, n° 13857. *In* CBH.
- **1** ♂, French Guiana, Saint Jean du Maroni, received from E. Le Moult – NHMUK 014199282. *In* NHMUK.
- **1** ♂, British Guiana, Potaro, May 1908 (S.M. Klages) – NHMUK 014199289. *In* NHMUK.

Description

Male (Fig. 5a & 5b)

Forewing length: 13 mm; wingspan: 27 mm.
Habitus similar to *T. marmorea*.

Genitalia ♂ (Fig. 6a, 6b & 6c). Similar to *T. marmorea* but the socii without differentiated setae. Aedeagus thin, cylindrical, longer than overall genital structure (4mm vs 3.3mm), and with a sclerotized trifid termination.

Female. – Unknown.

Immature stages. – Unknown.

Geographic distribution. – French Guiana and British Guiana.

Etymology. – The species name refers to the trifid extremity of the aedeagus, the adjective *tripertitus* in Latin meaning divided into three. It is an adjective in the nominative singular, gender feminine.

Discussion. – Our experience shows (see for example Herbin *et al.* 2021 for *Arotros*) that Apatelodidae species,being not long range fliers, have completely diverged between French Guiana and the coastal area of southeast Brazil, even though they show very similar habitus. This is again verified here. The photograph in fig. 7 illustrates the resting posture of *T. tripertita* **n. sp.**, which is typical of other species in this family. The extended position of the prothoracic legs, the raised posture over the substrate, and the abdomen significantly longer than the wings, can all be observed. In this position, the moth is reminiscent of a small piece of wood. Before settling in this posture, the moth oscillates slightly to each side several times, in a characteristic "dance" that is also seen with Hepialidae.

Tamphana awa Herbin, Mielke & Giusti **n. sp.**

(Fig. 8a, 8b, 9a, 9b & 9c)

ZooBank : https://zoobank.org/EA2F3153-9183-4C23-8408-CC0D5B761D31

Diagnosis. – Smaller than the two previous species, similar in habitus but with a darker brown ground colour. Better diagnostic characters are present on the male genitalia. The socii are equipped with long differentiated setae as in *T. marmorea*. Central projection of the saccus smaller and rounded (acute and triangular in *T. marmorea*) and the basal projection of the valvae is thin and digitiform (thick and rounded in *T. marmorea*). Overall size of male genitalia significantly larger in *T. marmorea*: 3 mm in length compared with 2mm in *T. awa* **n. sp.**

Holotype, ♂, bearing the following labels: Holotype ♂, *Tamphana awa*, Herbin, Mielke & Giusti 2024 – BRAZIL, MA[ranhão], Feira Nova do Maranhão, Retiro, 480 m, 21.II.2016, W 46°26'41", S 07°00'31", C. Mielke leg. − 31.879 Col. C. Mielke – Apatelodidae DZ 52.600, *Tamphana awa* ♂ HT, Prep. by C. Mielke 2024. *In* DZUP.

Paratypes (21 ♂)

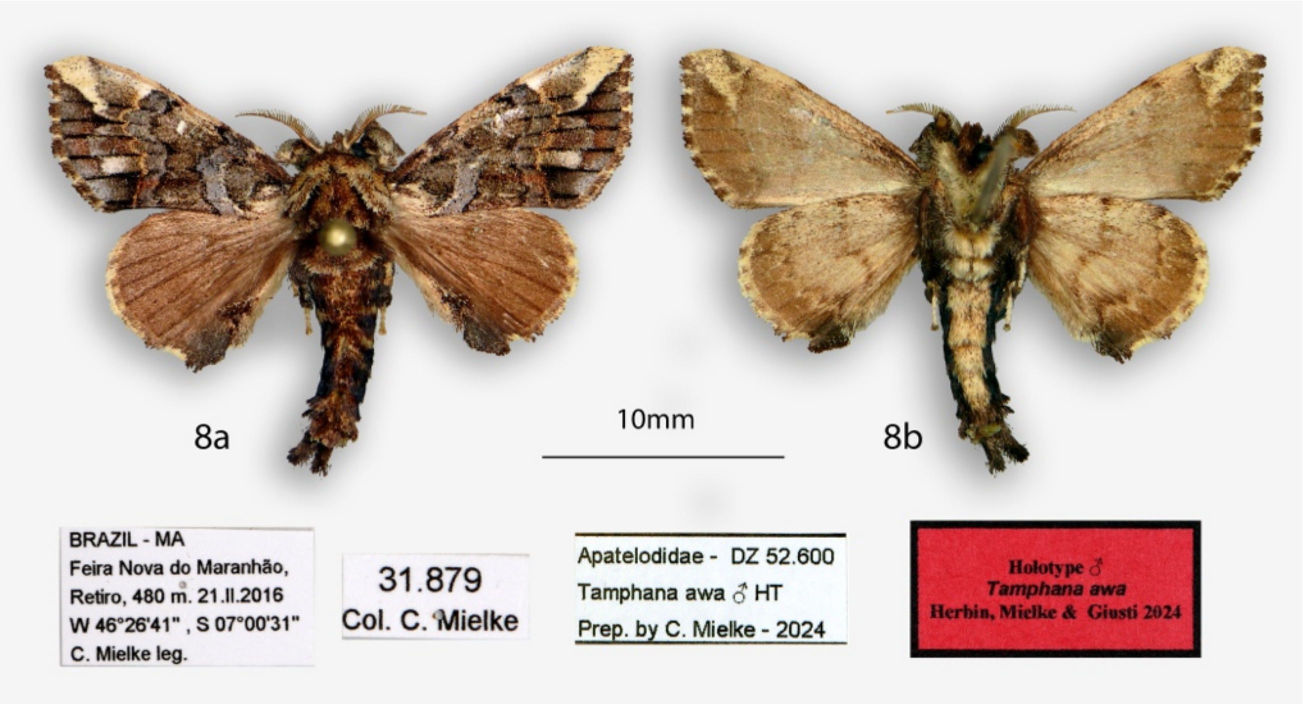
- **1** ♂, BRAZIL, Maranhão, Açailândia, 150 m, 19-27.XI.1990, *leg.* V.O. Becker & G.S. Dubois − gen. prep. USNM 156575. *In* USNM.
- **1** ♂, BRAZIL, Maranhão, Balsas, Serra do Penitente, 400 m, 12-14.XI.2012, 08°47'31"S 46°21'57"W, *leg.* C. Mielke − genitalia prep. D. Herbin ref H. 1143 – Barcode Bc-Her5005. *In* CDH.
- **2** ♂, BRAZIL, Maranhão, Balsas, Serra do Penitente, 400 m, 12-14.XI.2012, 08°47'31"S 46°21'57"W, *leg.* C. Mielke. *In* CDH.
- **17** ♂, BRAZIL, Maranhão, Feira Nova do Maranhão, Retiro, 480 m, 07°00'31"S 46°26'41"W, *leg.* C. Mielke. With the following collecting dates:
  23-24.XI.2013 (**3** ♂ CGCM 25.979, 26.170, 26.230);
  18-19.I.2014 (**3** ♂ CGCM 27.643, 27.660, 27.770);
  18-19.IV.2014 (**1** ♂ CGCM 28.478);
  7.XII.2014 (**4** ♂ CGCM 29.092, 29.616, 29.707, 28.887);
  23.I.2016 (**3** ♂ CGCM 31.671, 31.839, 31.889);
  21.II.2016 (**3** ♂ CGCM 4.882, 31.558, 31.828).
  In CGCM.

Description

Male (Fig. 8a & 8b).

Forewing length: 10-11 mm; wingspan: 21-23 mm.
Habitus identical to previous species, except for a smaller size and darker brown ground colour. Forewing less elongate, veins and double antemedial lines darker giving a more contrasted appearance.

Genitalia ♂ (Fig. 9a, 9b & 9c). Similar to *T. marmorea* but smaller overall (length 2 mm vs 3 mm), socii with long differentiated setae bent inwardly. Aedeagus thick, cylindrical, curved, with a sclerotized apex terminated with a



BRAZIL - MA
Feira Nova do Maranhão,
Retiro, 480 m. 21.II.2016
W 46°26'41" , S 07°00'31"
C. Mielke leg.

31.879
Col. C. Mielke

Apatelodidae - DZ 52.600
Tamphana awa ♂ HT
Prep. by C. Mielke - 2024

Holotype ♂
Tamphana awa
Herbin, Mielke & Giusti 2024

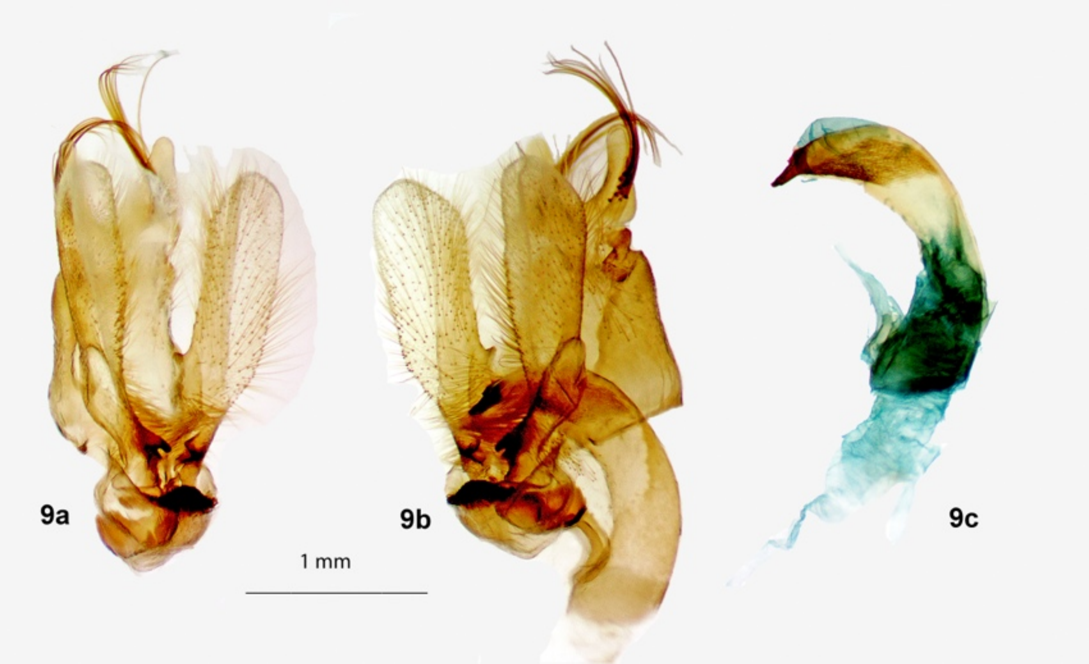


Fig. 8-9. *Tamphana awa* **n. sp.**

8. Holotype ♂. **a**. Upperside. **b**. Underside. (labels not to scale). **9**. Paratype ♂ genitalia (gen. prep. D. Herbin ref. H.1143). **a**. Left-ventral view. **b**. Right-lateral view with aedeagus in place. **c**. Aedeagus.

single strong spine. Saccus central projection rounded, basal projection of valvae thin and digitiform.

Female. – Unknown.

Immature stages. – Unknown.

Geographic distribution. – Brazil, Maranhão.

Etymology. – This species is dedicated to the indigenous Awa people of the Brazilian Amazon forest, a noun in the nominative singular standing in apposition to the generic name.

Discussion. – *Tamphana awa* **n. sp.** belongs to the Brazilian group of cryptic species (T. *marmorea* and *T. furtadoi* **n. sp.**) sharing the presence of long differentiated setae on the socii.

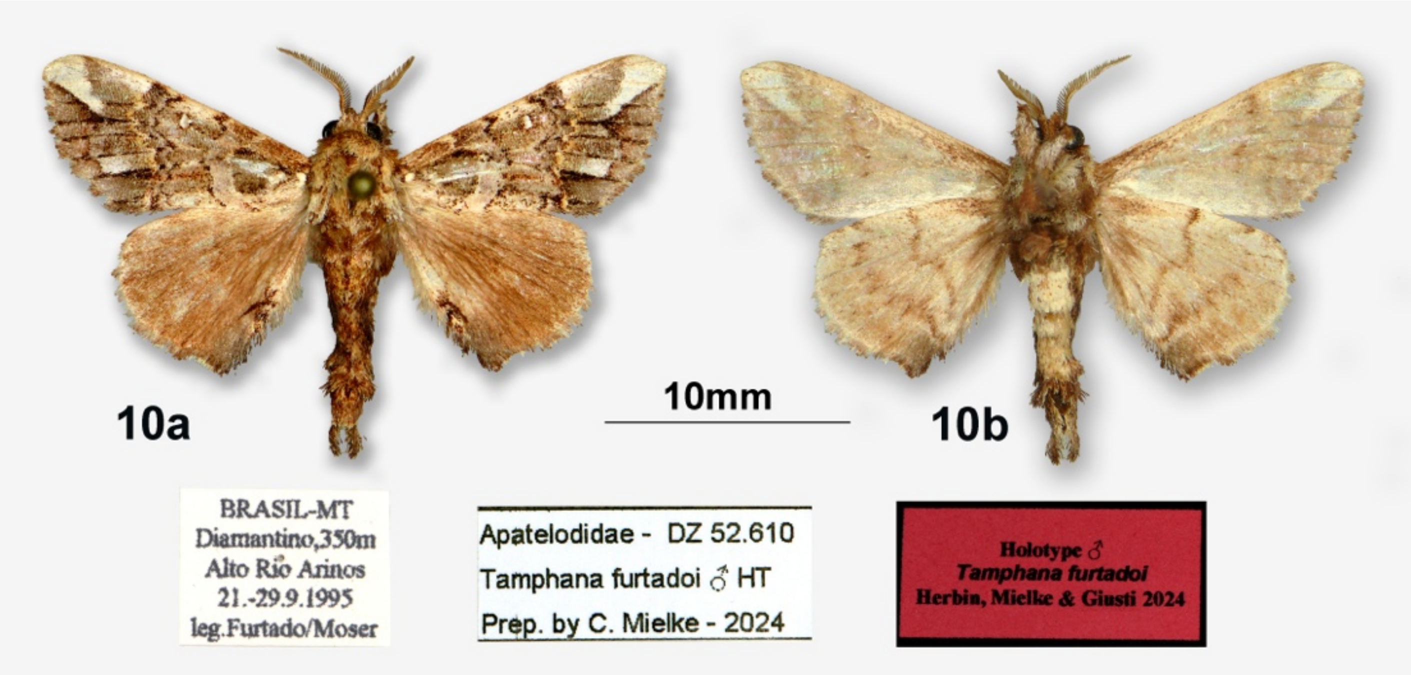
Tamphana furtadoi Herbin, Mielke & Giusti **n. sp.**

(Fig. 10a, 10b, 11a, 11b, 11c, 11d, 12a, 12b & 13)

ZooBank : https://zoobank.org/1E808F7C-084C-42A3-9C4A-9BFC20A9D856

Diagnosis. – Externally, *Tamphana furtadoi* **n. sp.** is similar to *T. marmorea* and *T. awa* **n. sp.** but can be recognized by the longer and more curved aedeagus with the apex bearing multiple small teeth, whereas ending in a single strong spine in its congeners.

Holotype, ♂, bearing the following labels: Holotype ♂, *Tamphana furtadoi*, Herbin, Mielke & Giusti 2024 – BRASIL, MT [Mato Grosso], Diamantino, 350 m, Alto Rio Arinos, 21.-29.9.1995, leg. Furtado/Moser − Apatelodidae - DZ 52.610; Tamphana furtadoi ♂ HT, prep. by C. Mielke – 2024 − CGCM 48533. Ex CLAM, *In* DZUP.



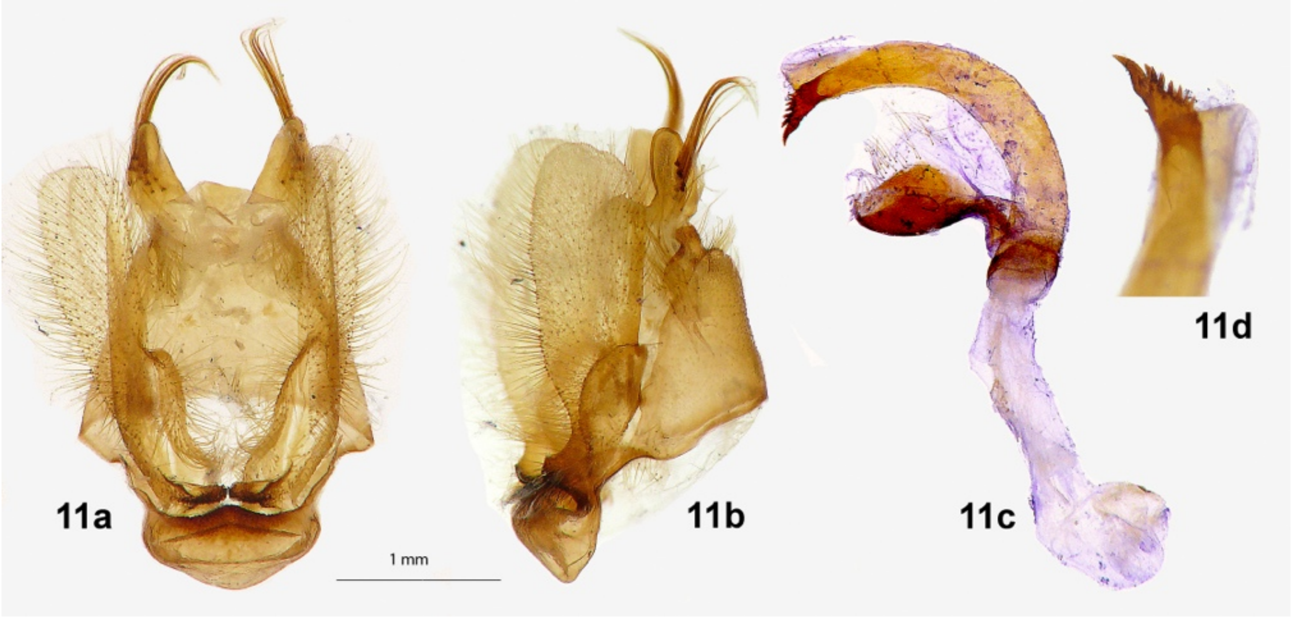


Fig. 10-11. *Tamphana furtadoi* **n**. **sp**., holotype ♂ (labels not to scale).

10. **a**. Upperside. **b**. Underside. **11**. Genitalia. **a**. Ventral view. **b**. Lateral view. **c**. Aedeagus (fultura inferior attached). **d**. Aedeagus apex detail (not at scale).

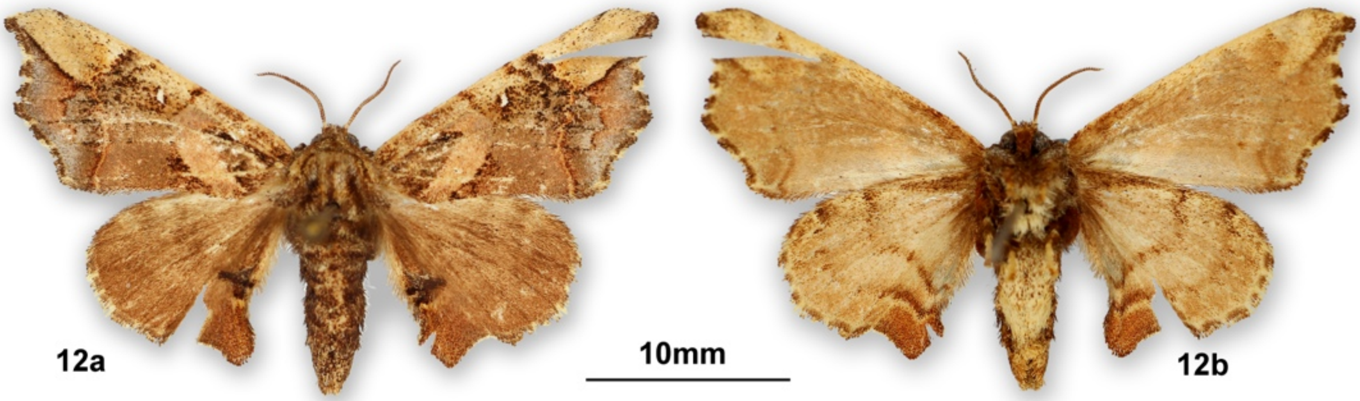


Fig. **12**. *Tamphana furtadoi* **n**. **sp**., paratype ♀ (Brazil, Mato Grosso, Chapada dos Guimarães).
a Upperside. **b**. Underside (gen. prep. and photographs A. Giusti, specimen on loan by courtesy USNM).

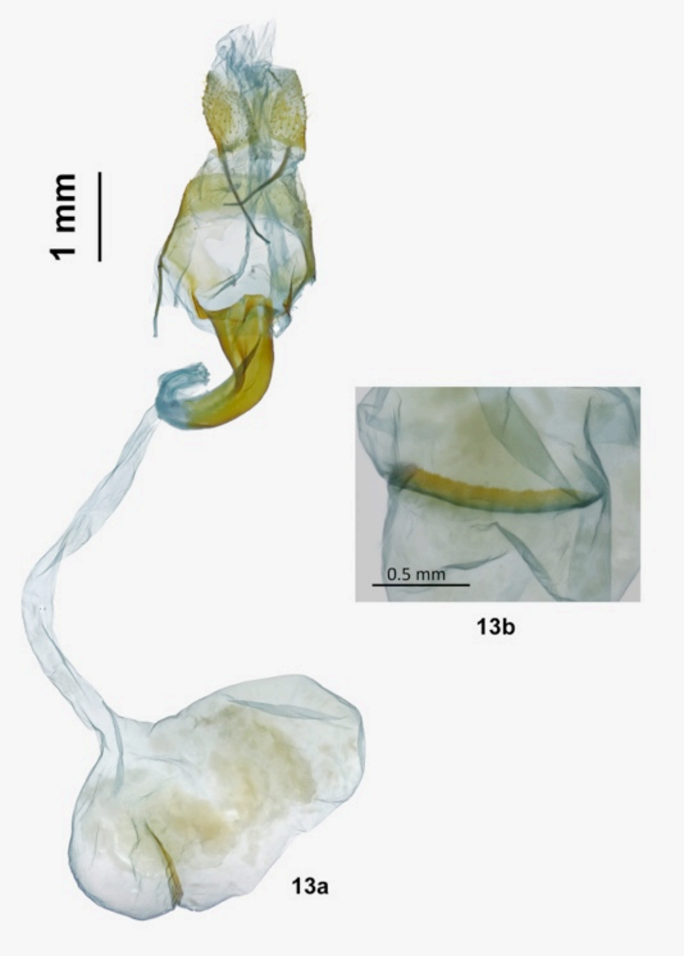


Fig. 13. *Tamphana furtadoi* **n. sp.**, paratype ♀ (Brazil, Mato Grosso, Chapada dos Guimarães). **a**. Genitalia, ventral view. **b**. Signum detail (genitalia preparation and photographs A. Giusti, specimen on loan by courtesy USNM).

Paratypes (**2** ♂, **1** ♀)

- **1** ♂ , BRAZIL, MT [Mato Grosso], Chapada dos Guimarães, 25.V.1989, *leg.*V.O. Becker. Gen. prep. USNM156577. *In* USNM.

- **1** ♀ , BRAZIL, MT [Mato Grosso], Chapada dos Guimarães, 800 m, 20.XI.1994, *leg.*V.O. Becker. Gen. prep. USNM156578. *In* USNM.

- **1** ♂, BRAZIL, MT [Mato Grosso], Diamantino, Alto Rio Arinos, 350 m, 7-13.XI.1996, *leg.* Furtado/Moser – CGCM 48.690. *In* CLAM.

Description

Male (Fig. 10a & 10b).
Forewing length: 10 mm; wingspan: 21 mm.
Habitus identical to previous species.

Genitalia ♂ (Fig. 11a, 11b, 11c & 11d). Similar to *T. marmorea* and *T. awa* **n. sp**. Basal projection of valvae digitiform, thick and straight, saccus projection round and wide, aedeagus cylindrical, strongly curved, with a sharply pointed apex bearing multiple and conspicuous small teeth.

Female (Fig. 12a & 12b)
Forewing length: 16 mm; wingspan: 32 mm
Habitus as for male, but thinner antennae and forewing with more produced apex, a first notch preapically in the termen, and a second notch towards the tornus.

Genitalia. (Fig. 13a,13b). Papillae anales semicircular, vertically elongated. Apophyses posteriores and anteriores of similar length and thickness. Eight tergite narrow and rectangular, lateral arms extended towards the lamella antevaginalis. Ostium bursae sinuous, leading to a heavily sclerotized and long infundibular antrum, recurved to the left. Ductus bursae membranous, approximately about same diameter along entire length and about one and a half times length of corpus bursae. Corpus bursae oval, membranous, with a single long and narrow signum bearing tiny irregular teeth pointing inward.

Immature stages. – Unknown.

Geographic distribution. – Brazil, Mato Grosso.

Etymology. – This species is dedicated to the late Brazilian entomologist Eurides Furtado. A noun in the genitive case.

Discussion. – As the previous species, *Tamphana furtadoi* **n**. **sp**. belongs to the *Tamphana marmorea* species group. This is the only *Tamphana* for which a female specimen was available for examination, with an interesting character in that the antennae are filiform, whereas they are bipectinate similarly to the males in a majority of other Apatelodidae species.

Tamphana tikuna Herbin, Giusti & Mielke **n**. **sp**.

(Fig. 14a, 14b, 15a, 15b & 15c)

ZooBank : https://zoobank.org/B767F184-F9AD-45B3-A888-139EB2311B53

Diagnosis. – With a wingspan of 23 mm *T. tikuna* **n. sp.** is one of the smaller species in the *marmorea* species-group, only *T. awa* **n. sp.** and *T. furtadoi* **n. sp.** are smaller at 21 mm. Habitus similar to other species of the *T. marmorea* complex. The male genitalia are diagnostic, particularly the long and curved aedeagus ending in a sclerotized rounded apex encircled by minute spines.

Holotype, ♂, bearing the following labels: Holotype ♂, *Tamphana tikuna* Herbin, Giusti & Mielke des. 2024, – Colombia, Amazonas, Puerto Nariño, San Juan del Socó, -3,742 -70,459, 80 m, 26-27.ix.2015, Rougerie Rodolphe., Barbut J. – Genitalia prep. D. Herbin ref H. 1625 – Instituto Humboldt Colombia, IAvH-E-191192. *In* IAVH.

Paratypes (**4** ♂)

- **1** ♂, Brazil, Amazonas, Teffé [Tefé], October 1907, *leg* M. de Mathan, NHMUK 014199288, prep. genitalia A. Giusti ref. NHMUK010402675. *In* NHMUK.

- **1** ♂, Peru, Madre de Dios, Rio Alto Madre de Dios, Pantiacolla lodge, 12°39.138'S 71°14.330'W, 449 m, 23.XI.2011, leg. G. Martin, BMNH(E) 2011-216, NHMUK 014199283, prep. genitalia A. Giusti ref. NHMUK010402679. *In* NHMUK.

- **1** ♂, Peru, Madre de Dios, Rio Alto Madre de Dios, Pantiacolla lodge, 12°39.342'S 71°13.912'W, 422 m, 02.XII.2011, leg. G. Martin, BMNH(E) 2011-216, NHMUK 014199284. *In* NHMUK.

- **1** ♂, Brazil, Amazons [Amazonas], Sao [São] Paulo &[de] Olivenca [Olivença], Jan. 1933, *leg* S. Waehner, Rotshchild Bequest B.M. 1939-1, NHMUK 014200685, prep. genitalia A. Giusti ref. NHMUK010402690. *In* NHMUK.

Description

Male (Fig. 14a & 14b).
Forewing length: 11 mm; wingspan: 23 mm.
Habitus identical to previous species.

Genitalia ♂ (Fig. 15a, 15b & 15c). Aedeagus thin, long, curved, with apex sclerotized and with multiple tiny spines. No differentiated setae on the two large, ear-like socii.

Female. – Unknown.

Immature stages. – Unknown.

Geographic distribution. – Colombia (Amazonas, Puerto Nariño), Brazil (Amazonas), Peru (Madre de Dios)

Etymology. – The new species is named in honour of the local native Americans, the Tikuna people. A noun in the nominative singular standing in apposition to the generic name. Gender feminine.

Discussion. – Although the habitus is very similar to other species in the *marmorea* and *ampliata* species-groups, the male genitalia enable one to easily distinguish this species, in particular the very long aedeagus with a sclerotized apex encircled by minute spines. DNA barcoding confirms the inclusion of this species in a group with *T. tripertita* **n. sp.**, and *T. awa* **n. sp**. with a distance greater than 4% to the other nearest species, as shown in Fig. 45.

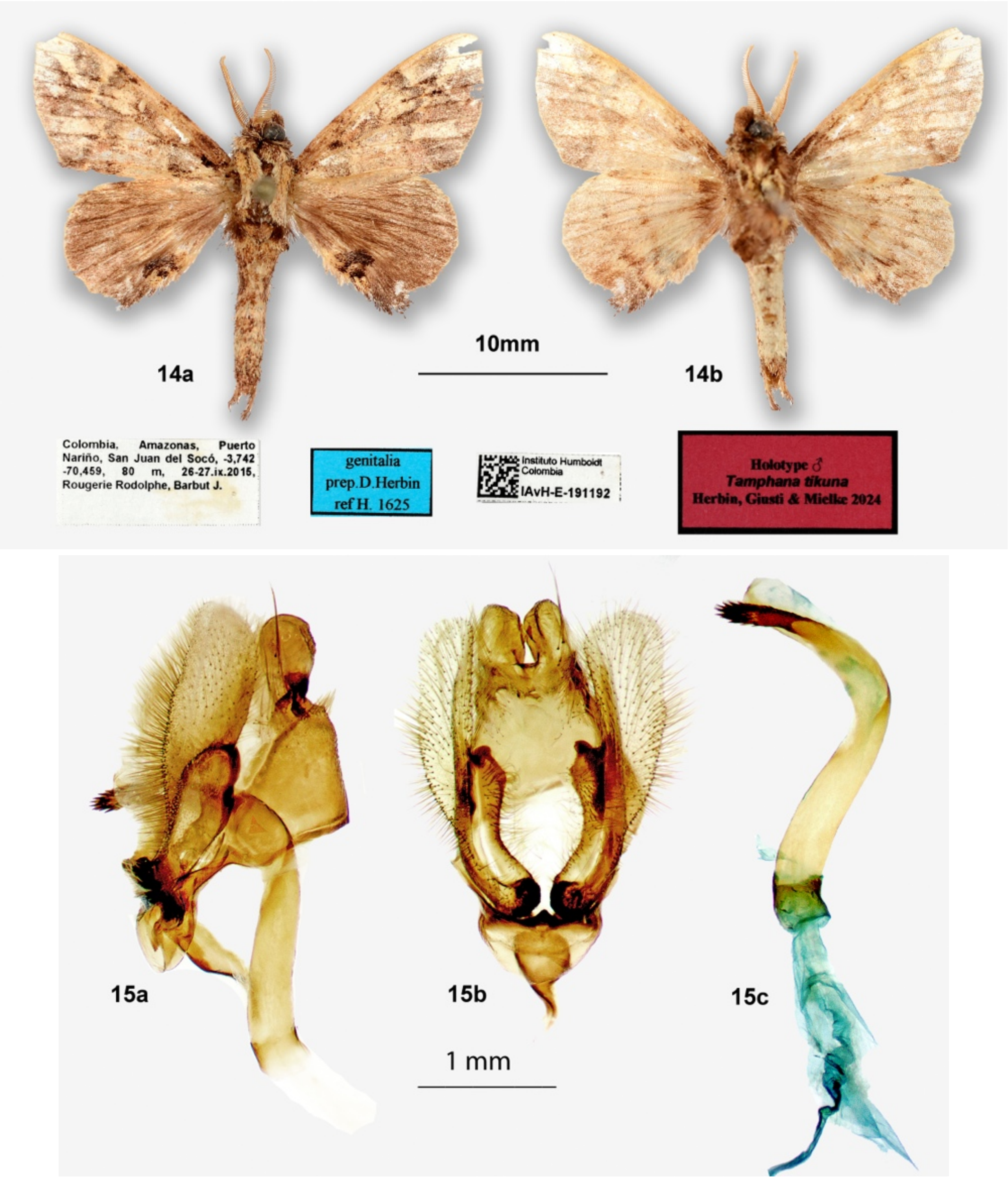

14a
10mm
14b
Colombia, Amazonas, Puerto Nariño, San Juan del Socó, -3,742 -70,459, 80 m, 26-27.ix.2015, Rougerie Rodolphe, Barbut J.
genitalia prep.D.Herbin ref H. 1625
Instituto Humboldt Colombia
IAvH-E-191192
Holotype ♂ Tamphana tikuna Herbin, Giusti & Mielke 2024
15a
15b
15c
1 mm

Fig. 14-15. *Tamphana tikuna* **n**. **sp**., holotype ♂.

14. **a**. Upperside. **b**. Underside (labels not to scale). **15**. Genitalia. **a**. Lateral view aedeagus in situ. **b** Ventral view without aedeagus. **c**. Aedeagus.

Tamphana lojanara Schaus, 1929

(Fig. 16a,16b & 17)

Tamphana lojanara Schaus, 1929: 692
Tamphana lojanara; Becker (1996: 16)
Tamphana lojanara; Kitching *et al.* (2018: suppl. material 1)

Diagnosis. – Although *T lojanara* has a similar habitus to the other species in the *marmorea* and *ampliata* species-groups it is slightly larger, and easily distinguished by two small discocellular ivory dots and zigzagged lines in the ivory patch near the apex.

Holotype, ♂, bearing the following labels: *Tamphana lojanara* type Schs – Environs de Loja, Equateur, 1890 – Type n°34348 U.S.N.M. – Dognin collection – *In* USNM (examined, but not dissected).

Description

Male (Fig. 16a & 16b).

Forewing length: 15 mm; wingspan: 31 mm.
Forewing shows two small discocellular ivory dots. Ivory patch at apex of forewing crossed by wavy brown lines.

Genitalia ♂. Not examined.

Female. – Unknown.

Immature stages. – Unknown.

Geographic distribution. – Ecuador: Loja surroundings.

Discussion. – So far, *T. lojanara* is only known from the holotype. Chloe and Trevor Van Loon gave us permission to reproduce

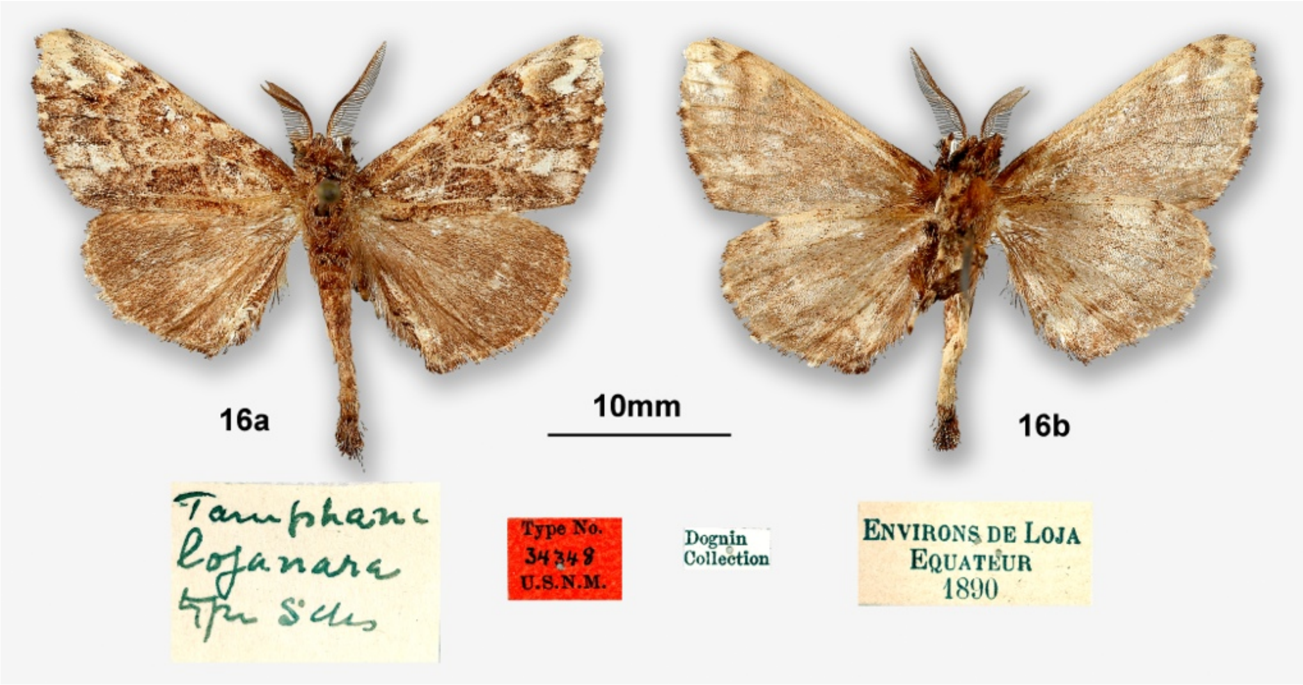


Fig. 16. *Tamphana lojanara* holotype ♂. **a**. Upperside. **b**. Underside (Photographs D. Herbin, courtesy USNM, labels not to scale).

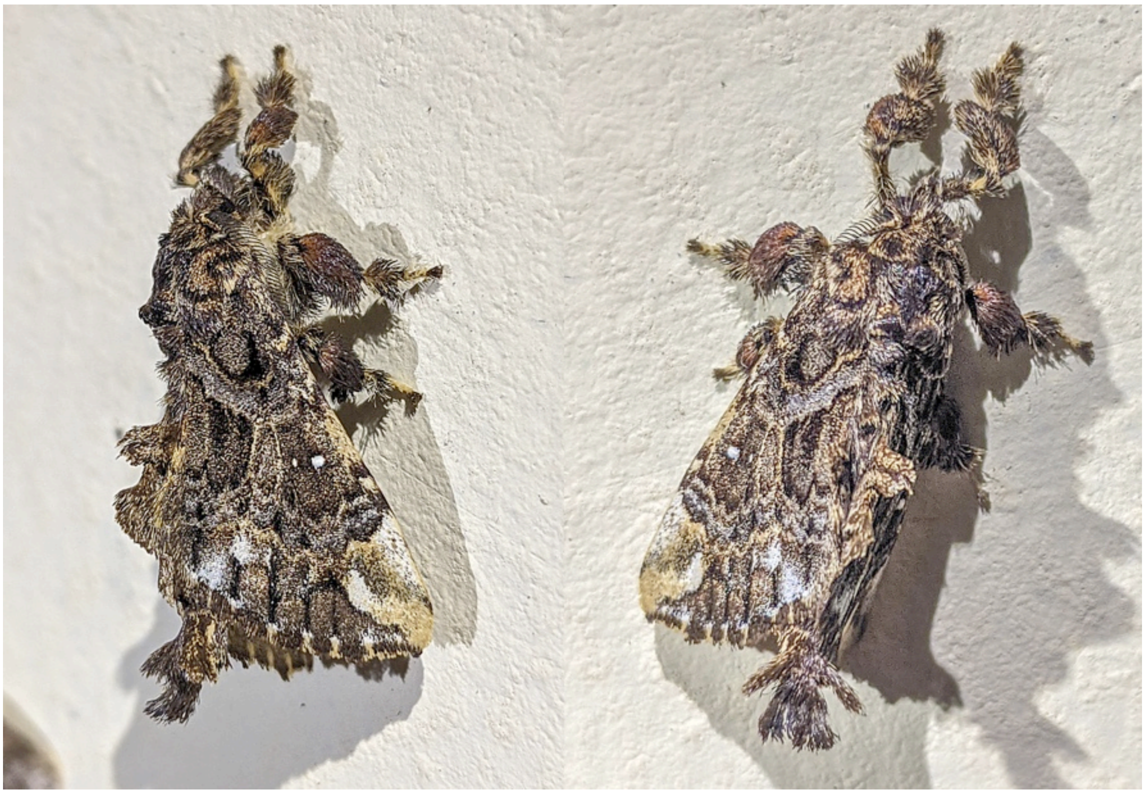


Fig. 17. Putative *Tamphana lojanara* ♂, resting position (courtesy C. & T. Van Loon, photograph taken in Ecuador Oriente, Napo, with permission). The patch of long scales present on forewing anal margin can be seen as protruding from the back of the moth, in lateral view. The position of the piliform scales in the anal tuft is also well visible.

photographs they took in Ecuador Oriente, Napo, Wild Sumaco Lodge, 1661m. The double discocellular dot on the forewing can be clearly seen, together with wavy lines in the ivory patch near apex. This specimen is provisionally referred to *T. lojanara*, although there is a question mark given the holotype of *T. lojanara* originates from Loja (with no precise locality given), and the entomological fauna of the central plateau is generally different from that on the oriental side of the Andes.

Tamphana ampliata n. sp. species-group

The extreme modification of the male genitalia in the *ampliata* species-group, compared with those of the *marmorea* species-group is remarkable, and raised the question of whether they should not be classified into two distinct genera. We decided not to take this step, because these two groups, showing cryptic imagos, with the same tibial spur and venation configurations, are relatively close in the overall tree based on BOLD COI

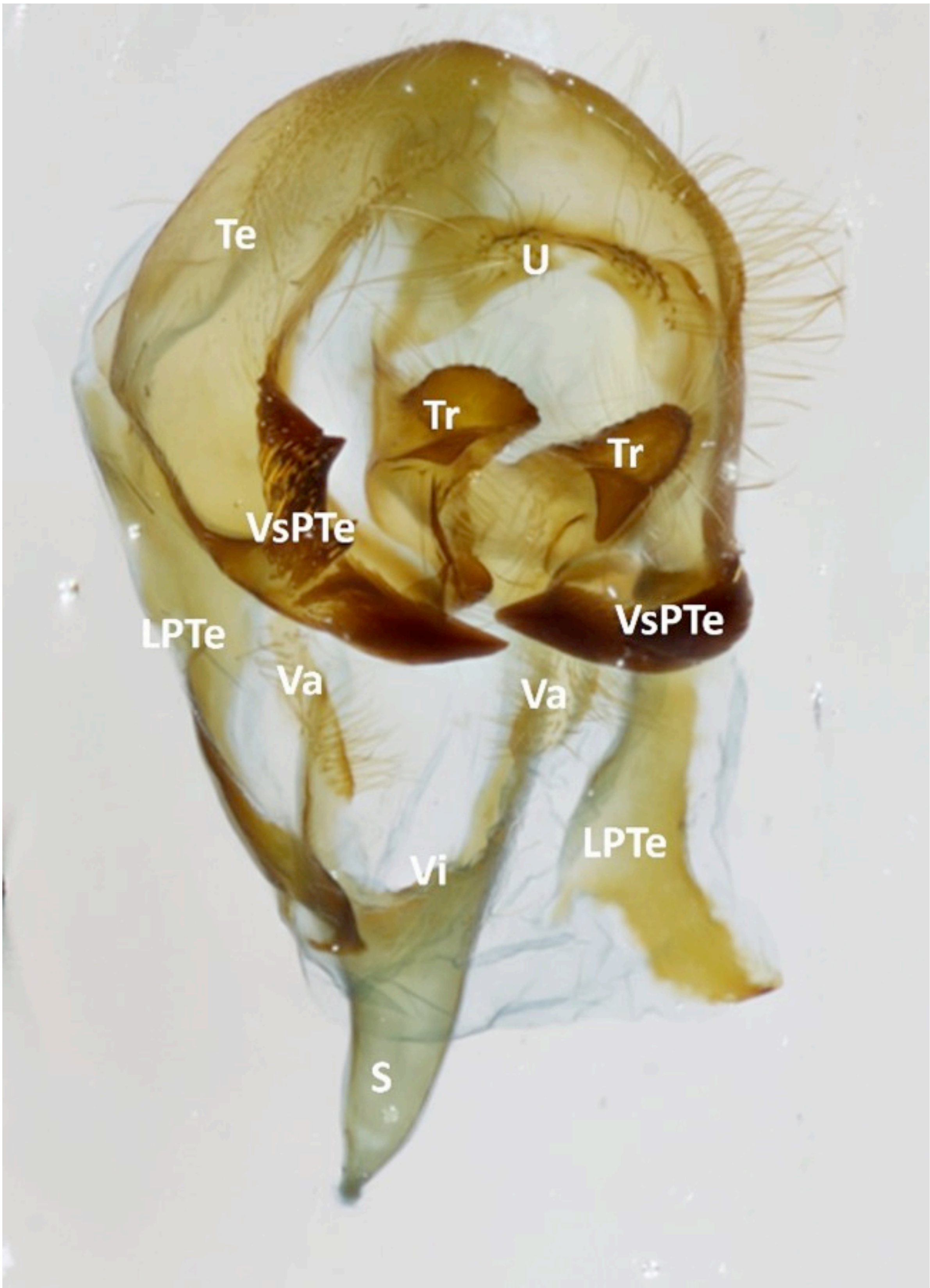


Fig. **18**. Terminology used for the various parts of *T. ampliata* **n**. **sp**. species-group genitalia.

Te. Tegumen. **LPTe**. Lateral Projection of Tegumen. **VsPTe**. Ventral Sclerotized Projection of Tegumen, U/ Uncus. **Tr**. Transtilla. **Va**. Valva. **Vi**. Vinculum. **S**. Saccus.

sequences (although a distance greater than 10% exists between the two groups). Fig. 18 is based on male genitalia of a specimen from Costa Rica, Alajuela, from USNM 156576.

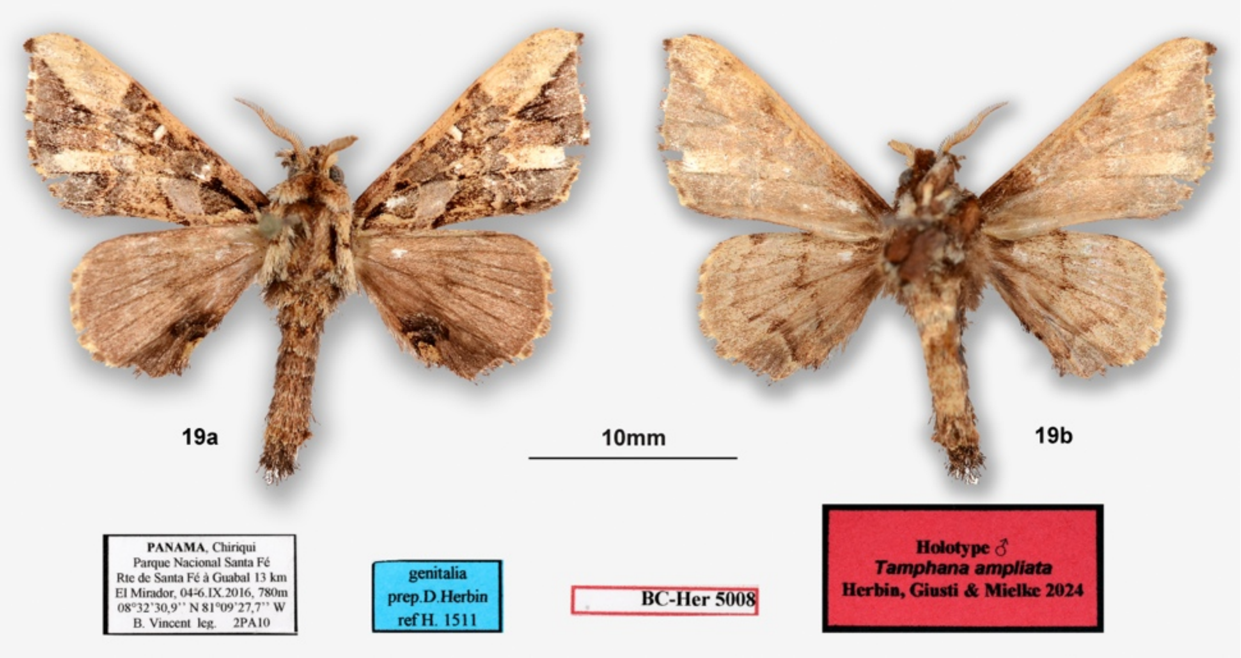
Tamphana ampliata Herbin, Giusti & Mielke **n**. **sp**.

(Fig. 19a,19b, 20a, 20b, 20c & 21)

ZooBank : https://zoobank.org/691909AB-1B22-4514-823C-1BB47D7973A6

Diagnosis. – The habitus of this species is again similar to the members of *marmorea* species-group but has the triangular ivory patch at the apex of the forewing significantly enlarged, enabling it to be easily distinguished. The genitalia are even more diagnostic with a spherical genital capsule and the aedeagus apex long, thin, tapering to a point and curving inwardly. The tooth-like ventral projections of the tegumen are strongly sclerotized in all three species of the *ampliata* species-group and they seem to vary also individually in their shape and asperities. However, *T. ampliata* **n**. **sp**. shows slightly more robust projections, particularly on the right side. The uncus is more compact and rounded than in *T. picobonitensis* **n**. **sp**. and *T. lauriei* **n**. **sp**. The transtillae lack the upper pointed and claw-like part that is present in *T. picobonitensis* **n**. **sp**., and have the lower parts more rounded and sclerotized than in both *T. picobonitensis* **n**. **sp**. and *T. lauriei* **n**. **sp**. The two membranous lateral projections of tegumen end in a more rounded and downcurved tip than in *T. lauriei* **n**. **sp**. The saccus shorter than in *T. lauriei* **n**. **sp**. and with a more rounded tip than in *T. picobonitensis* **n**. **sp**. The aedeagus shows a large bulbous part just above the vesica opening and before the curved tip. The tapering tip of the aedeagus is long and strongly curved inward compared with the other two species of the group.

Holotype, ♂, bearing the following labels: Holotype ♂, *Tamphana ampliata*, Herbin, Giusti & Mielke 2024 – Panama, Chiriqui, Parque Nacional Santa Fé, R[ou]te de Santa Fé à Guabal 13 km, El Mirador, 04-6.IX.2016, 780m, 08°32'30.9" N 81°09'27.7"W, B. Vincent leg. 2PA10 – genitalia prep. D. Herbin ref H. 1511 – [Barcode] Bc-Her5008. *In* MNHN.



PANAMA, Chiriqui
Parque Nacional Santa Fé
Rte de Santa Fé à Guabal 13 km
El Mirador, 04-6.IX.2016, 780m
08°32'30,9'' N 81°09'27,7'' W
B. Vincent leg. 2PA10

genitalia
prep.D.Herbin
ref H. 1511

BC-Her 5008

Holotype ♂
Tamphana ampliata
Herbin, Giusti & Mielke 2024

Fig. **19**. *Tamphana ampliata* **n**. **sp**., holotype ♂. **a**. Upperside. **b**. Underside (labels not to scale).

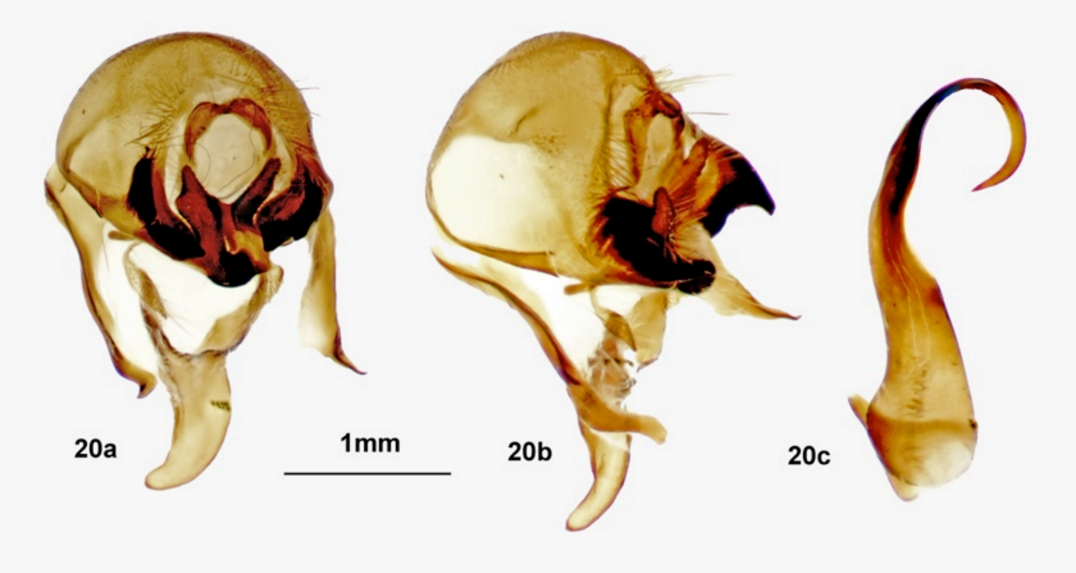


Fig. **20**. *Tamphana ampliata* **n**. **sp**., paratype ♂ genitalia (ref. H. 1644). **a**. Ventral view. **b**. Lateral view. **c**. Aedeagus.

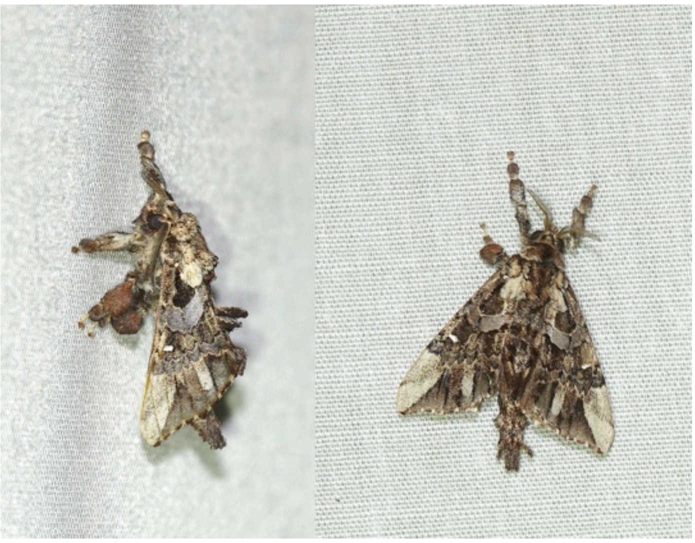


Fig. 21. *Tamphana ampliata* **n**. **sp**., resting position (photographs L. & J. Harrison in Panama, with permission). The patch of long scales present on forewing anal margin can be seen as protruding from the back of the moth, in lateral view. Anal tuft in a W configuration is also visible in top view.

Paratypes (**9** ♂)

- **1** ♂, Costa Rica, Limon, Veragua Rainforest Campamento, 9.5532N 83.1129W, 450 m, 12-15.III.2010, *leg* J. Bolling Sullivan. − BSGenTamp.1. *In* BSC.
- **1** ♂, Costa Rica, Limon, Veragua Rainforest Campamento, 9.5532N 83.1129W, 450 m, 12-15.III.2010, *leg* J. Bolling Sullivan. − BSGenTamp.2. *In* BSC.
- **1** ♂, Panama, Panama prov., Los Altos de Cerro Azul, 9.2030N 79.4150W, 700 m, 23.II.2021, *leg* L. & J. Harrison − genitalia prep. D. Herbin ref H. 1644. *In* CDH.
- **1** ♂, Panama, Panama prov., Los Altos de Cerro Azul, 9.2030N 79.4150W, 700 m, 21.III.2021, *leg* L. & J. Harrison. *In* CDH.
- **3** ♂, Venezuela, Palma Sola, (NHMUK014200558, NHMUK014199291, NHMUK014199290). *In* NHMUK.
- **1** ♂, Venezuela, Las Quigas, Esteban Valley, 1914-180, NHMUK 014199287, prep. genitalia A. Giusti ref. NHMUK010402677. *In* NHMUK.
- **1** ♂, Ecuador, Pichincha, Pacto-Guayabillas, 1800 m, 1.V.2003, *leg*. A. Moser, prep. genitalia C. Mielke ref. CGCM 48690. *In* CLAM.

Description

Male (Fig. 19a & 19b)

Forewing length: 13 mm; wingspan: 27mm.
Similar to previous species but with the subtriangular ivory patch from the apex along the costa enlarged and reaching discal cell distally.

Genitalia ♂ (Fig. 20a, 20b & 20c). Aedeagus with a strongly curved sclerotized apex, proboscis-like, with a swollen, bulbous part before the curved tip. Tip of aedeagus curved toward vesica opening.

Female. – Unknown.

Immature stages. – Unknown.

Geographic distribution. – Central America: Panama, Costa Rica. South America: Ecuador Occidente (Pichincha), Venezuela.

Etymology. – The name is derived from the Latin adjective *ampliatus* meaning enlarged, in relation with the diagnostic enlarged ivory triangle at apex of the forewing. An adjective in the nominative singular.

Discussion. – Although similar to all previous species, the Central American specimens are immediately recognizable by the enlarged subtriangular ivory patch reaching apex of the forewing. DNA barcode analysis reveals a divergence of 2 to 3 % which raises a question mark as to whether or not they are separate species (fig. 45). Further studies are required to determine whether further separation within the Central American distribution range is required.
In the CLAM collection there is one specimen from Ecuador Occidente, Pichincha, Pacto-Guayabillas, 1500m, of rather large size and with an enlarged ivory patch. Examination of its genitalia showed them to be identical to those of Central American specimens. The same applies to specimens from Venezuela, Palma Sola and Las Quigas. Therefore, we included all these specimens as paratypes.
Photographs of a live specimen from Panama are shown in Fig. 21.
Note: As the aedeagus of the holotype has a broken tip, the genitalia (which are otherwise identical) of a paratype from Panama are figured.

Tamphana picobonitensis Herbin, Giusti & Mielke **n**. **sp**.

(Fig. 22a, 22b, 23a, 23b & 23c)

ZooBank : https://zoobank.org/C041236D-08B6-4F50-A7FC-78C559235892

Diagnosis. – Habitus similar to the previous species with the same enlarged ivory patch near forewing apex. The male genitalia show a broader and less curved uncus than in the *T. ampliata* species group, and with an evident mesally protruding ledge. The distal parts of both transtillae are elongated and claw-like shape, unlike in *T. ampliata* **n**. **sp**. and *T. lauriei* **n**. **sp**. where the distal part is digitiform. Proximal part of transtillae much more reduced and less sclerotized than in the other two species of the *ampliata* species-group. Saccus more triangular, pointed and shorter than in both *T. ampliata* **n**. **sp**. and *T. lauriei* **n**. **sp**. The aedeagus is also diagnostic with a reduced and only slightly curved acute apex.

Holotype, ♂, bearing the following labels: Holotype ♂, *Tamphana picobonitensis*, Herbin, Mielke & Giusti 202ND4 – HOURAS, Atlantida, P.N. Pico Bonito, 80-250 m, 15°41.5'N 86°54.1'W, 24.06[VI]-2.07[VII].2010, A. Moser *leg*. – DZ 52.620 – genitalia prep. C. Mielke CGCM 48.458 – *In* DZUP.

Paratypes (**3** ♂)

- **1** ♂, Costa Rica, Alajuela, Estacion Botarrama, Manta Loma, 10.295897N 85.428527W, 200 m, 27.IX.2008 − 08-SRNP-106651 − gen. prep. USNM 156576. *In* USNM.
- **1** ♂, Costa Rica, Guanacaste, Sector del Oro, Bosque Aguirre, 11.004N 85.441W, 571 m, 7.VI.2008 − 08-SRNP-102597. *In* USNM.
- **1** ♂, Costa Rica, Guanacaste, Sector del Oro, Manta Matudaea, 10.9969N 85.4568W, 610 m, 14.V.2008 − 18-SRNP-102211. *In* USNM.

Description

Male (Fig. 22a & 22b).

Forewing length: 13 mm; wingspan: 27mm.
Habitus similar to previous species, with the same large ivory apical patch on the forewing.

Genitalia ♂ (Fig. 23a, 23b & 23c). Uncus wide with an evident mesally protruding ledge. VsPte right side with the two teeth of the same size. Three to six sharply pointed sclerotized setae between the teeth. Lobes of the transtilla elongated with a claw-like distal part, the left more developed and seemingly more prominent than the right, which has a pointed apex. Aedeagus with a short, straight or only slightly curved, acute apex

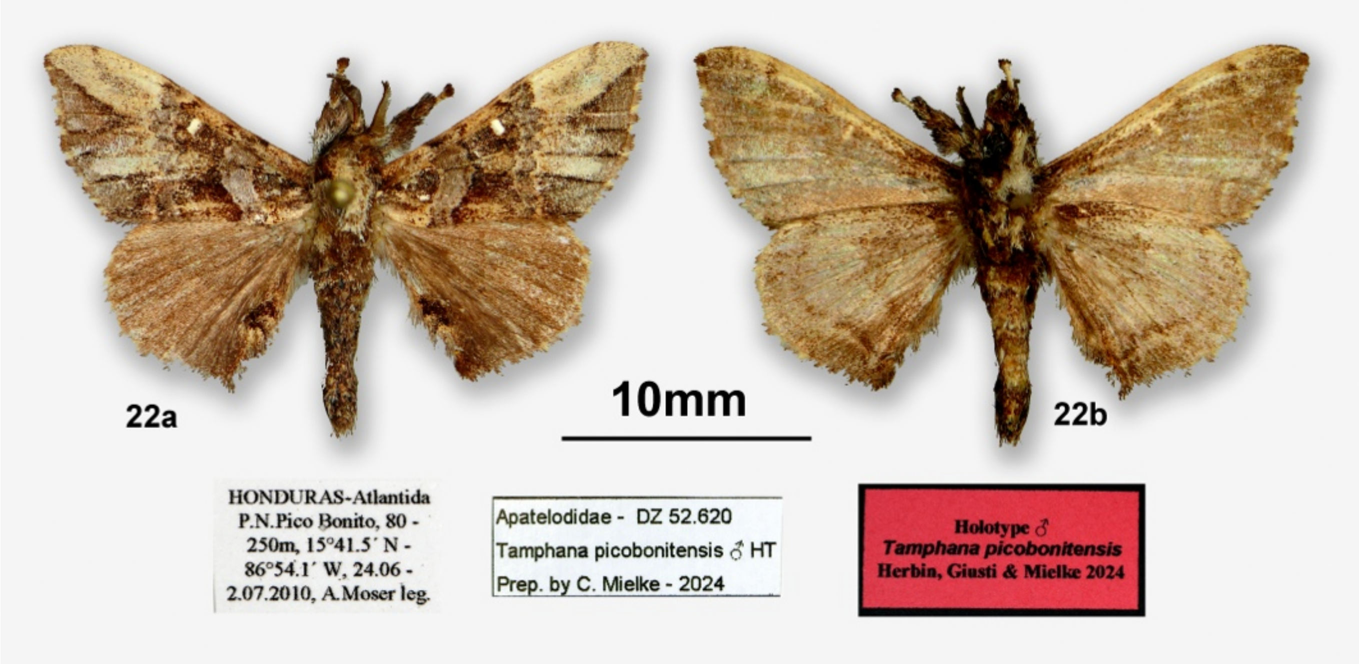
Female. – Unknown.

Immature stages. – Unknown.

Geographic distribution. – Honduras: type locality; Costa Rica: Guanacaste, Alajuela.

Etymology. – The name is derived from the locality of the holotype: Pico Bonito. An adjective in the nominative singular.

Discussion. – Only the Costa Rican paratypes have been barcoded, and show a distance between 2 and 3% from *T. ampliata* **n**. **sp**.



HONDURAS-Atlantida
P.N.Pico Bonito, 80 -
250m, 15°41.5´ N -
86°54.1´ W, 24.06 -
2.07.2010, A.Moser leg.

Apatelodidae - DZ 52.620
Tamphana picobonitensis ♂ HT
Prep. by C. Mielke - 2024

Holotype ♂
Tamphana picobonitensis
Herbin, Giusti & Mielke 2024

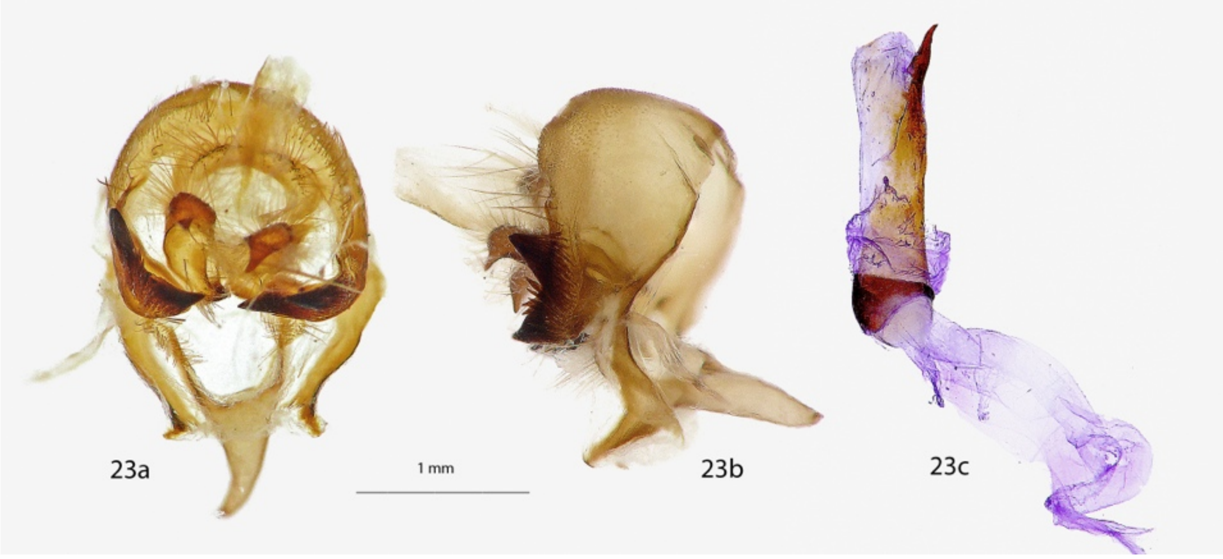


Fig. 22-23. *Tamphana picobonitensis* **n. sp.**, holotype ♂.
22. **a**. Upperside. **b**. Underside (labels not to scale). **23**. Genitalia. **a**. Ventral view. **b**. Lateral view. **c**. Aedeagus.

Tamphana lauriei Giusti, Herbin & Mielke **n. sp.**

(Fig. 24a, 24b, 25a, 25b & 25c)

ZooBank : https://zoobank.org/1873B605-10A4-4104-91A6-648F4B46E361

Diagnosis. – The habitus is identical to other members of the *ampliata* species-group. Male genitalia are similar to those of *T. ampliata* **n. sp.** and *T. picobonitensis* **n. sp.** but smaller in size, and like the latter, *T. lauriei* **n. sp.** has a relatively straight aedeagus but one that is much longer and thinner than in *T. picobonitensis* **n. sp.** The vesica opening of the aedeagus is larger than in *T. ampliata* **n. sp.**, and *T. lauriei* **n. sp.** lacks the swollen, bulbous part before the curving tip of that species. The two membranous lateral projections of tegumen end in a pointed and clearly upwardly bent tip compared to *T. ampliata* **n. sp.** and *T. picobonitensis* **n. sp.** in which the tips are more rounded and bent slightly downward. There are also some clear differences in the sclerotized parts of the valvae, which look smaller and have less pointed teeth, and the saccus is longer and slimmer than in the other species in the *ampliata* species-group.

Holotype, ♂, bearing the following labels: Holotype ♂, *Tamphana lauriei*, GIUSTI, HERBIN & MIELKE 2024 – Belize, Cayo District, Las Cuevas Research Station, 16°44'11.5"N 88°59'30.4"W/01.vii.2002/G. Martin & A. T. Watson/ BMNH(E) 2002-115 – Killed with Ethyl Acetate – BMNH(E) #674332 – NHMUK014199286. NHMUK010402678 vial [gen.prep]. *In* NHMUK.

Paratypes (**1** ♂)

- **1** ♂, Belize, Cayo, Chiquibul, Forest, Las Cuevas Field Station, 16°43'N 88°59'W 500-700 m, V.2010, H.MENDEL & MVL BARCLAY – BMNH(E) 2010-54/At Light – NHMUK 014199285. NHMUK010402689 vial [gen.prep.]. *In* NHMUK.

Description

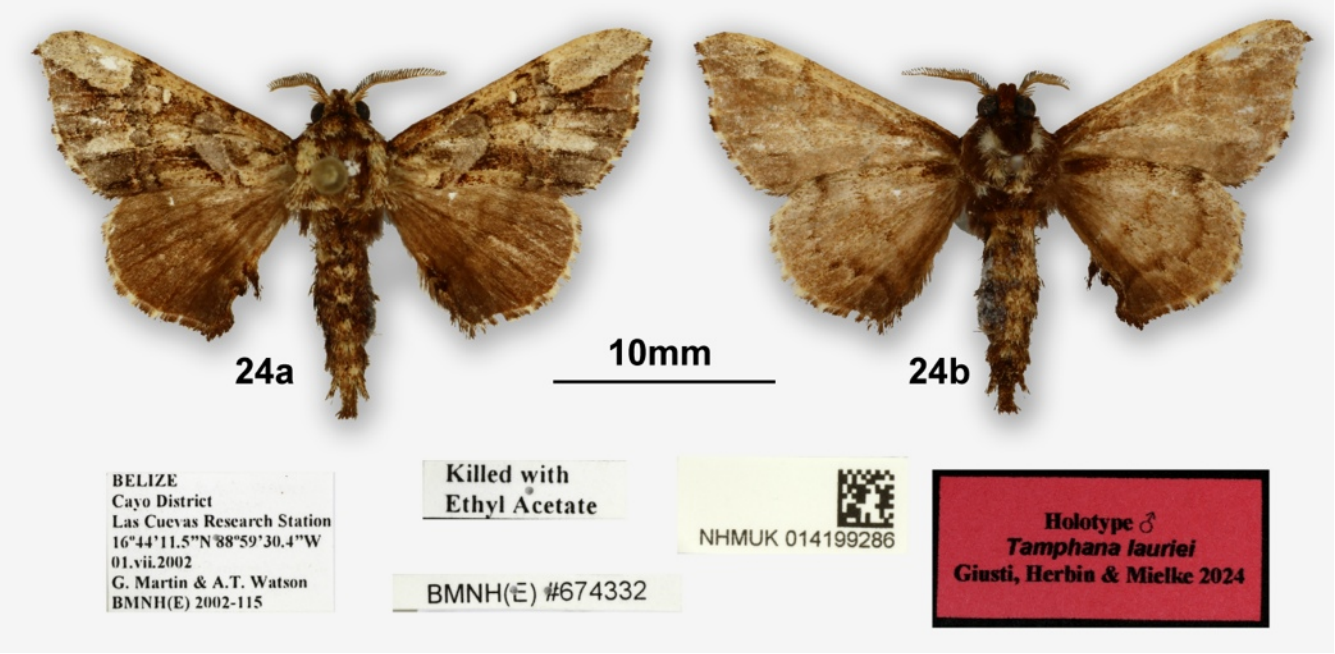
Male (Fig. 24a & 24b).

Forewing length: 11.5-13 mm; wingspan: 25-27.5mm.
Habitus similar to previous species, with the same large ivory apical patch on the forewing.

Genitalia ♂ (Fig. 25a, 25b & 25c). Male genitalia are of the *ampliata* species-group type. Aedeagus straight, thin and long, only slightly curving, with a large vesica opening. Saccus long, slim and with a rounded tip.

Female. – Unknown.

Immature stages. – Caterpillars samples can be found in BOLD public records that originate from Mexico, Quintana Roo and Campeche, at the following URL: http://www.boldsystems.org/index.php/



BELIZE
Cayo District
Las Cuevas Research Station
16°44'11.5"N 88°59'30.4"W
01.vii.2002
G. Martin & A.T. Watson
BMNH(E) 2002-115

Killed with
Ethyl Acetate

BMNH(E) #674332

NHMUK 014199286

Holotype ♂
Tamphana lauriei
Giusti, Herbin & Mielke 2024

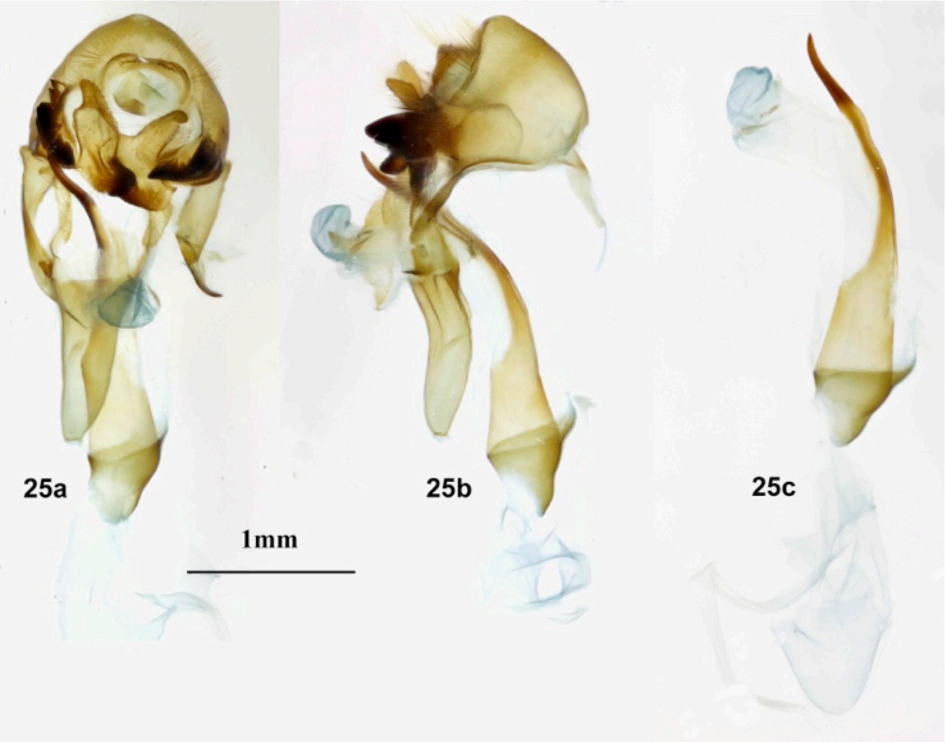


Fig. **24-25**. *Tamphana lauriei* **n**. **sp**., holotype ♂.

24. **a**. Upperside. **b**. Underside (labels not to scale). **25**. Genitalia. **a**. Ventral view aedeagus in situ. **b**. Lateral view. **c**. Aedeagus.

Public_RecordView?processid=LPYPB920-08. Given the proximity of these Mexican states to Belize, we tentatively assign these records to *T. lauriei* **n**. **sp**., although specimens of *T. lauriei* **n**. **sp**. from Belize will need to be barcoded to be certain.

Geographic distribution. – Belize.

Etymology. – This species is dedicated to Laurence (Laurie) David Mason, a young enthusiastic biologist and dear friend of A. Giusti who thanks him for his support and friendship and for his animated but always enlightening discussion on many aspects of the sciences. A noun in the genitive case.

Discussion. – The aedeagus enables this species to be determined within the central American group. Our hypothesis is that there are three Central American species, two on the Atlantic side and one on the Pacific side. However, this needs confirmation from the collection of more specimens from the Atlantic side and their DNA barcoding.

Tamphana praecipua species-group

Tamphana inferna Dognin, 1916

(Fig. 26a & 26b)

Tamphana inferna Dognin, 1916: 7-8
Tamphana inferna; Schaus (1929: 692)
Tamphana inferna; Becker (1996: 16)
Tamphana inferna; Kitching *et al.* (2018: suppl. material 1)

Diagnosis. – Similar in size to most species of *Tamphana*, but with the forewings appearing more elongate, as also in *T. praecipua* Schaus, 1905. Wings upperside uniformly brown, almost without distinctive

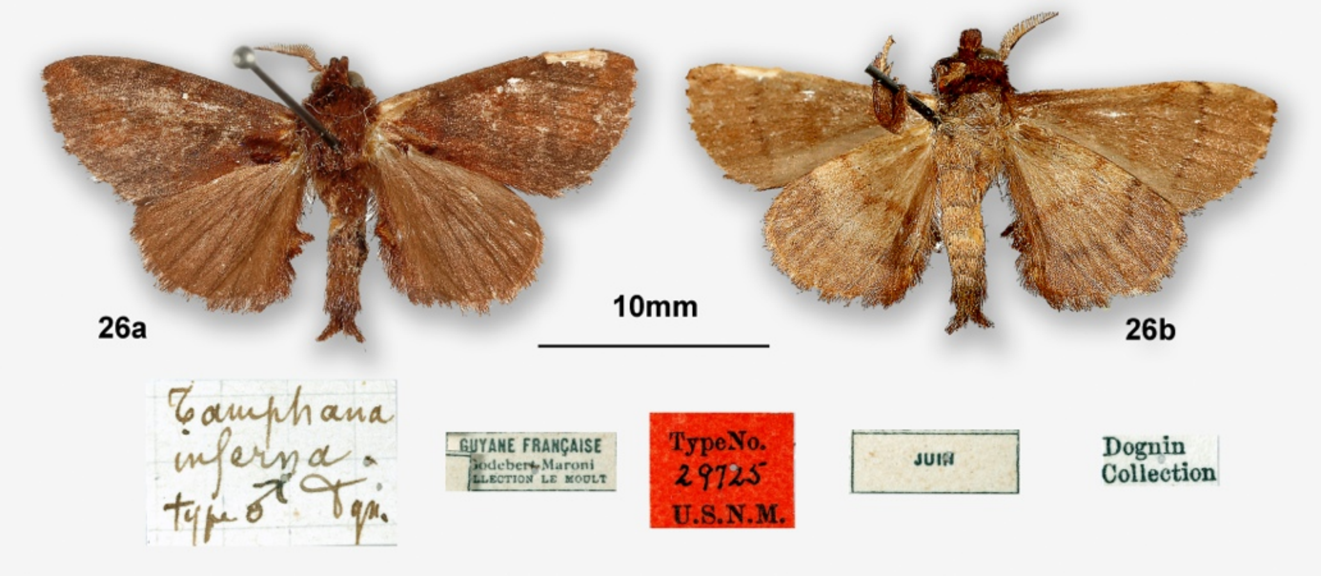

26a
10mm
26b
Tamphana inferna. type ♂ Dgn.
GUYANE FRANÇAISE Godebert, Maroni COLLECTION LE MOULT
TypeNo. 29725 U.S.N.M.
JUIN
Dognin Collection

Fig. 26. *Tamphana inferna* holotype ♂. **a**. Upperside. **b**. Underside (labels not to scale) (photographs D. Herbin, courtesy USNM).

markings, except a tiny whitish spot at the upper end of the discal cell of the forewing. Abdomen with a V-shaped anal tuft.

Holotype, ♂, bearing the following labels: *Tamphana inferna* type ♂ Dgn. – Guyane Française [French Guiana] Godebert, Maroni, Collection Le Moult – Juin – Type n° 29725 U.S.N.M. – Dognin Collection. *In* USNM (examined, but not dissected).

Redescription

Male (Fig. 23a & 23b)

Forewing length: 12 mm; wingspan: 25 mm.
Bipectinate antennae to tip, light brown. Thorax mahogany brown (79,33,15), legs brown with thick vestiture.
Forewing subtriangular, with termen slightly convex, upperside homogeneous fawn brown (111,62,35), slightly darker along costa, a tiny whitish spot at upper end of discal cell, no clearly visible lines. Hindwing upperside homogeneous clay brown (130,88,50) with no visible lines or distinctive markings. Forewing and hindwing underside homogeneous brown beige (157,118,62) with a medial and a postmedial darker brown lines.
Abdomen upperside mahogany brown, underside sand yellow (196,162,108), anal tuft V-shaped.
Genitalia ♂. – Not examined.

Female. – Unknown.

Geographic distribution. – French Guiana: Godebert, Saint-Laurent-du-Maroni.

Discussion. – This species is only known from the holotype. Examination of various collections that are mainly constituted of specimens from French Guiana, including collections Hermier, Bénéluz, Collet, but also NHMUK and MNHN, did not reveal further specimens of this species, nor did we capture any during our numerous collecting nights in French Guiana. Collection of fresh specimens to allow DNA barcoding and analysis together with genitalia examination is needed to confirm the inclusion of this species within *Tamphana*.

Tamphana praecipua Schaus, 1905

(Fig. 27a, 27b, 28a, 28b & 28c)

Tamphana praecipua Schaus, 1905: 298
Tamphana praecipua; Schaus (1929: 693)
Tamphana praecipua; Becker (1996: 16)
Tamphana praecipua; Kitching *et al.* (2018: suppl. material 1)

Diagnosis. – A small species (wingspan 26mm), similar to *T. inferna* in being uniformly brown but with beige markings along the forewing costa near the apex and at basal one third of the wing length. In addition, there is a tiny beige spot below the apex, where a hyaline spot is often found in other Apatelodidae, is present.

Holotype, ♂, bearing the following labels: *Tamphana praecipua* type Schs – St Jean, Maroni, F.[rench] Guiana – Type n° 8802 U.S.N.M. – Collection WmSchaus. *In* USNM (examined).

Additional material examined (2 ♂)

- **1** ♂, Guyane Française, St. Jean du Maroni, collection Le Moult/Dognin collection/ USNMENT 01921648/ Spec. fig./ [Handwritten label]: *Tamphana praecipua* Sch[au]s, Eupterotidae, Sch[au]s W[ashing]ton 12/19. *In* USNM.
- **1** ♂, French Guiana, Godebert-Maroni, November, Collection Le Moult. *In* NHMUK.

Redescription

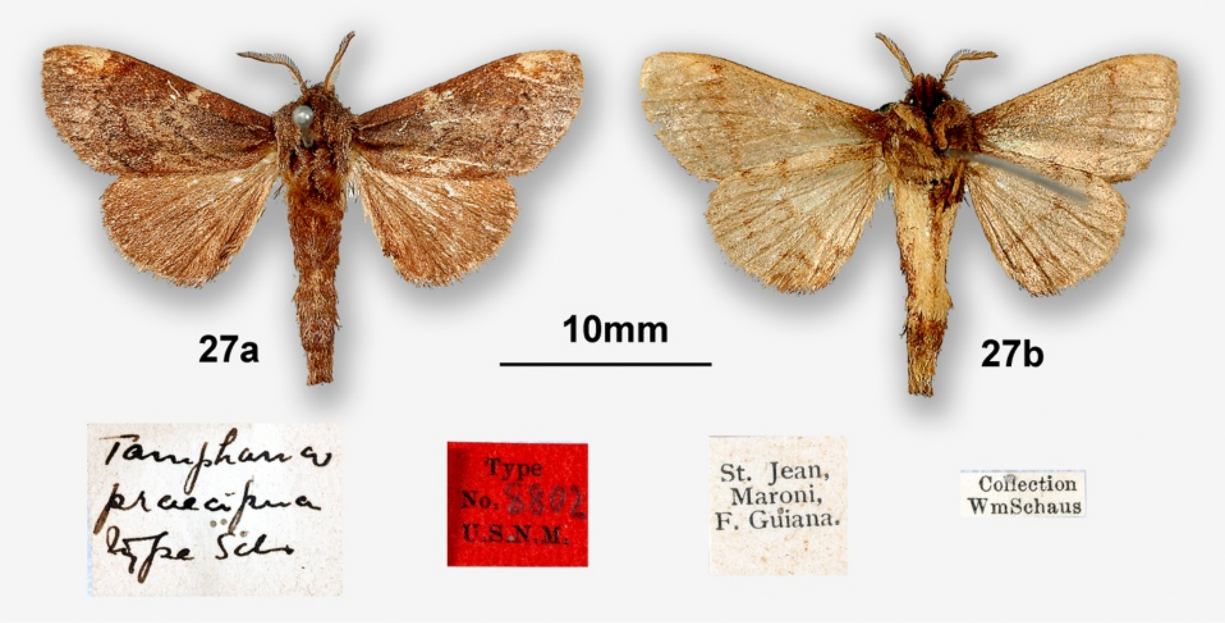
Male (Fig. 27a & 27b).

Forewing length: 12.5 mm; wingspan: 26 mm.
Antennae light brown. Thorax mahogany brown (66,27,9), legs with thick vestiture. Forewing subtriangular, elongate, with termen convex, upperside ground colour clay brown (124,70,35) with a beige spot (191,158,113) near costa at approximately one third of wing, distally bordered by a barely visible brown antemedial line. Another larger beige patch along costa before apex, proximally bordered by a double parallel brown postmedial line. A tiny beige spot below apex. A tiny beige spot at extremity of discal cell. Hindwing upperside homogeneous brown beige (174,130,86).
Forewing and hindwing underside beige (221,192,132) with barely visible reddish brown postmedial line on forewing and medial and postmedial lines on hindwing.
Abdomen upperside clay brown (116,58,19) and underside ivory (221,198,145).
Genitalia ♂ (Fig. 28a, 28b & 28c). Unique in that the valva apex has a double spiny process, like a crab claw, and a third spiny process arising from the costa at two thirds of its length. Uncus membranous with two sclerotized socii. Aedeagus rather short (shorter than valvae), curved and cornuti absent.

Female. – Unknown.

Geographic distribution. – French Guiana, along the Maroni river.

Discussion. – This species is similar to the previous in wingspan, wing shape and ground colour, and is likely sympatric. Both inhabit the same geographic zone along the Maroni river and the border with Suriname. Like the previous species, *T. praecipua* is also rare in collections, being so far known only from two specimens in USNM and one in NHMUK, the latter of which was



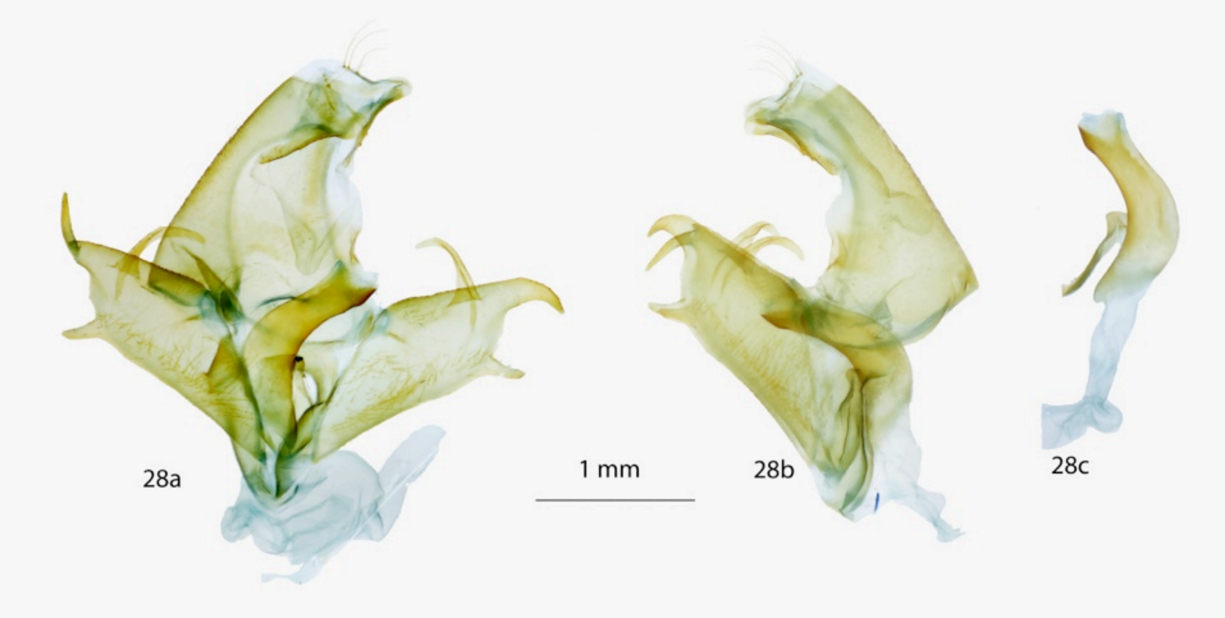


Fig. 27-28. *Tamphana praecipua* holotype ♂.

27. **a**. Upperside. **b**. Underside (labels not to scale) (photos D. Herbin, courtesy USNM). **28**. Genitalia (from a specimen NHMUK 014200559, prep. genit. A. Giusti ref. NHMUK010402684). **a**. Ventral view. **b**. Lateral view. **c**. Aedeagus.

used for genitalia preparation. The male genitalia are markedly different from all the other *Tamphana* species, supporting a case for placing this species and the previous species in a separate genus. From a label attached to second specimen in USNM, and which originated from Dognin collection, we see that Schaus examined and determined it in December 1919, and therefore it is not a syntype. The only specimen available and used by Schaus for description in 1905 is thus confirmed to be the holotype, and a lectotype designation is thus not needed.

Tamphana lucifer n. sp. species-group

Tamphana lucifer Herbin Giusti & Mielke **n**. **sp**.

(Fig. 29a, 29b, 30a, 30b & 30c)

ZooBank : https://zoobank.org/9A447C2D-16C9-4D5B-9DA5-6062DA4944A6

Diagnosis. – Another small species (23 mm wingspan), with clearly less elongate forewings than in the two other uniformly brown species, *T. praecipua* and *T. inferna.* Diagnostic of *T. lucifer* **n**. **sp**. are also the dark brown dorsum of the thorax and abdomen, the brown beige (RGB 170,123,74) wings, the thin, brown antemedial and postmedial lines, a tiny beige discocellular dot and a darker brown and a black mark in basal area of the forewing. Abdomen ivory ventrally. Tibial spur formula: 0-2-2. Male genitalia with a simple short sclerotized uncus, surrounded by a pair of socii equipped with numerous very long setae (as long as valvae). Aedeagus very short (one third of the valvae length) with one small cornutus on the vesica.

Holotype, ♂, bearing the following labels: Holotype ♂, *Tamphana lucifer* HERBIN, GIUSTI & MIELKE des. 2024 – Mont Lucifer (Guyane Française) [French Guiana] – Mare sommet - UV, 20 octobre 2014 – Genitalia prep. D. Herbin ref H. 1623 – Code-barres ADN: BC-MNHN-LEP00803. *In* MNHN.

Paratypes (**3** ♂)

- **1** ♂, French Guiana, Route forestière de Bélizon, Montagne Tortue pk24.7, 15.X.1999, *leg*. B. Hermier – Hermier n° 16890 – Genitalia prep. D. Herbin ref H. 1510. *In* CDH.
- **1** ♂, French Guiana, Nouragues research station, 6.IX.2012, 4.098, -52.68, *leg*. C. Lopez Vaamonde – Code-barres ADN: BIOUG00729-E05. *In* MNHN.
- **1** ♂, French Guiana, Piste Bélizon km 20, 04°18'56.52"N 52°25'16.99W, Alt. 88 m, 25.IX.2013, *leg*. D. Herbin/O. Felis. *In* CDH.

Description

Male (Fig. 29a & 29b).

Forewing length: 11 mm; wingspan: 23 mm.
Antennae bipectinate to the tip, brown beige. Thorax mahogany brown (58,21,6), legs with thick vestiture, tibial spur formula 0-2-2. Abdomen dorsally sepia brown (70,53,44) with intersegments paler brown, ventrally dark ivory, anal tuft V-shaped. Forewing upperside with convex termen, homogeneous brown beige (174,129,80), with darker mahogany brown (58,23,11) markings along inner margin on proximal half. A tiny mahogany brown spot at extremity of discal cell. Darker brown antemedial, medial and postmedial lines, weakly distinct.
Hindwing upperside homogeneous beige brown (136,89,59) slightly darker than forewing upperside. Ante and postmedial lines not discernible.
Fore- and hindwing underside homogeneous brown beige (179,129,86) with slightly darker medial and postmedial line, weakly marked.

Genitalia ♂ (Fig. 30a, 30b & 30c). A short simple uncus bent 90° (seen from profile on semi ventral view in fig. 30b), bordered on each side by a well developed socius, twice as long as uncus, and equipped with long differentiated setae (as long as valvae). Aedeagus short, about one third the length of the valva, with one cornutus.

Female. – Unknown.

Immature stages. – Unknown.

Geographic distribution. – French Guiana.

Etymology. – The name is homonym of the type locality in French Guiana: Mont Lucifer. A noun in the nominative singular standing in apposition to the generic name.

Discussion. – The configuration of male genitalia with these long setae on the socii is similar to those found in the *marmorea* species-group, but the short aedeagus is distinctly different. In contrast, they are not at all similar to those of *praecipua* species-group. The habitus, with more rounded, less elongated forewings, is also different from all species addressed above. In the overall phylogenetic tree of Apatelodidae, *T. lucifer* is found with more than 9% distance from all other *Tamphana* species, nevertheless in the same branches of the tree. This being added to the tibial spurs 0-2-2 arrangement, and the ivory ventral side of abdomen, justify that we keep this species within *Tamphana* genus.

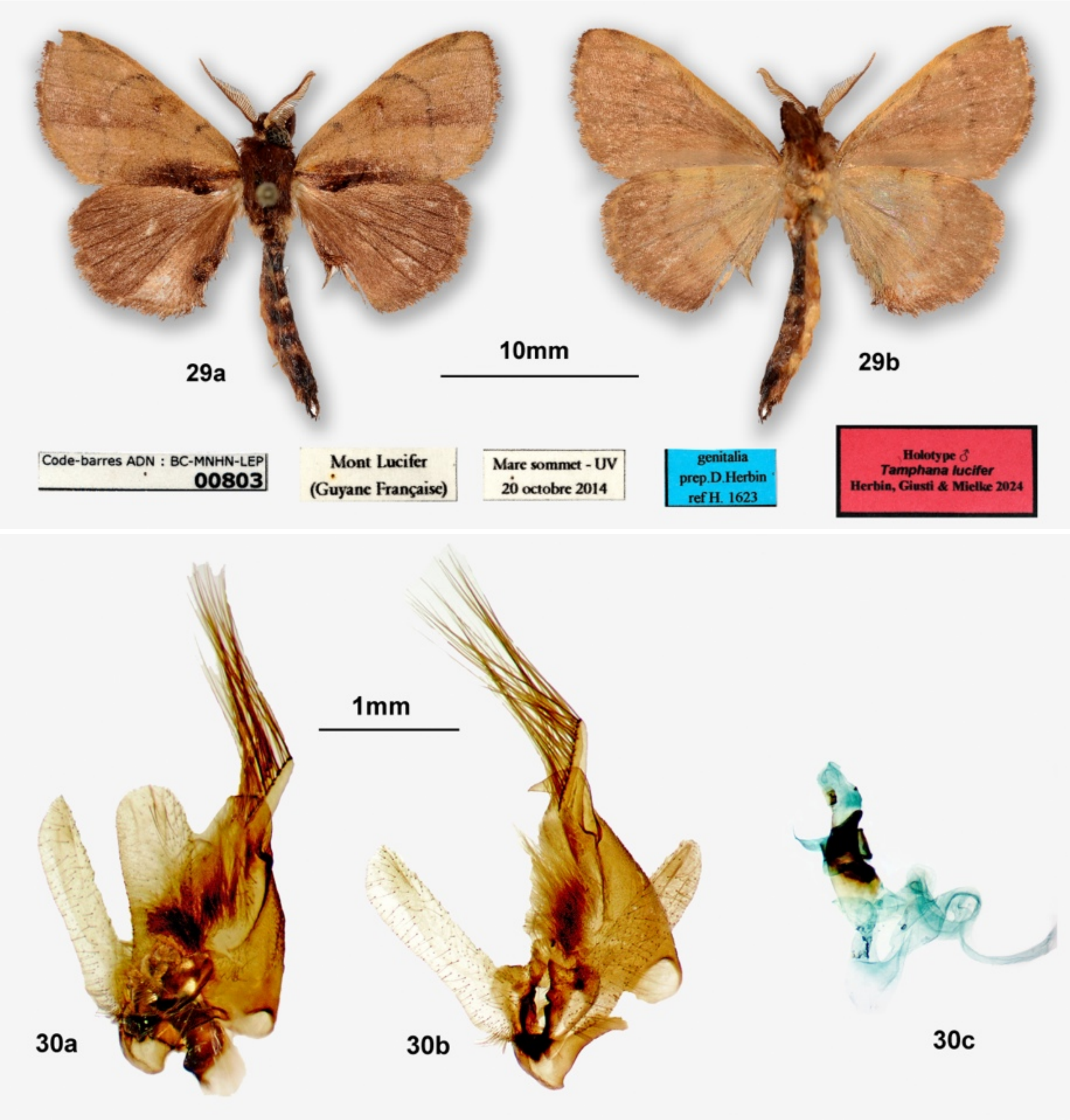


Fig. 29-30. *Tamphana lucifer* **n. sp.**, holotype ♂.

29. **a**. Upperside. **b**. Underside (labels not to scale). **30**. Genitalia (ref. H. 1623). **a**. Lateral view aedeagus in situ. **b**. Latero-ventral view without aedeagus. **c**. Aedeagus.

Tamphana paranensis n. sp. species-group

Tamphana paranensis Herbin, Giusti & Mielke **n**. **sp**.

(Fig. 31a, 31b, 32a, 32b, 32c & 32d)

ZooBank : https://zoobank.org/F79F974B-6104-49EF-B236-E013E6B4B213

Diagnosis. – With a wingspan of 22 mm, *Tamphana paranensis* **n**. **sp**. is one of the smallest species in the genus. The outer margin of the forewings is more rounded and the apex more falcate than in all of its congeners. The uniform chocolate brown colour with a darker brown patch at apex of forewing is also diagnostic. The antennae are dark brown, darker than any congeneric species. The ventral side of the abdomen is beige with a brown terminal section. The male genitalia show some similarities with those of *T. praecipua* genitalia. However, the membranous uncus is more rectangular, shorter and with more pointed sclerotized socii. Moreover, the valvae are oval and not end like a crab claw, as they do in *T. praecipua*, but similary to this species they bear a spine-like process arising dorsally about two-thirds from the apex of the valva. A second tiny triangular process arises below this dorsal one. The aedeagus is slightly longer and less curved than in *T. praecipua*. . Based on its habitus and genitalia, *T. paranensis* **n**. **sp**. cannot be confused with any other congeneric species.

Holotype, ♂, bearing the following labels: Holotype ♂, *Tamphana paranensis* Herbin, Giusti & Mielke 2024 – BRAZIL –PR [Paraná], Ponta Grossa, Estrela, 25.X.2016, C. Mielke *leg*. – 32.898 Col. C. Mielke – Apatelodidae - DZ 52.630, *Tamphana paranensis*, prep. by C. Mielke - 2024. *In* DZUP.

Paratypes (1 ♂)

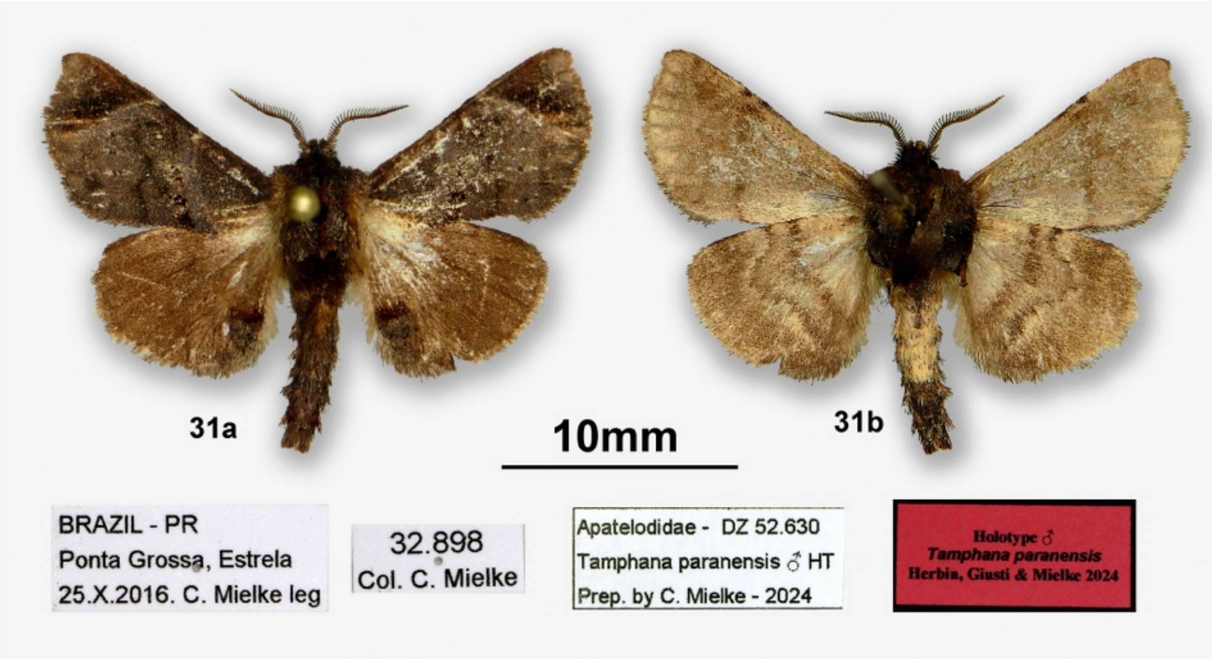
- **1** ♂, Brazil, Minas Gerais, Conceição dos Ouros, Rio Sapucaí, 800m, 27.XI.1998, *leg*. G. Pereira – Genitalia prep. D. Herbin ref H. 1694 In CDH.

Description

Male (Fig. 31a & 31b).

Forewing length: 10.5 mm; wingspan: 22 mm.

Antennae bipectinate to the tip, dark brown. Head and thorax chocolate brown (32,22,11), legs brown black, with thick vestiture, tibial spur



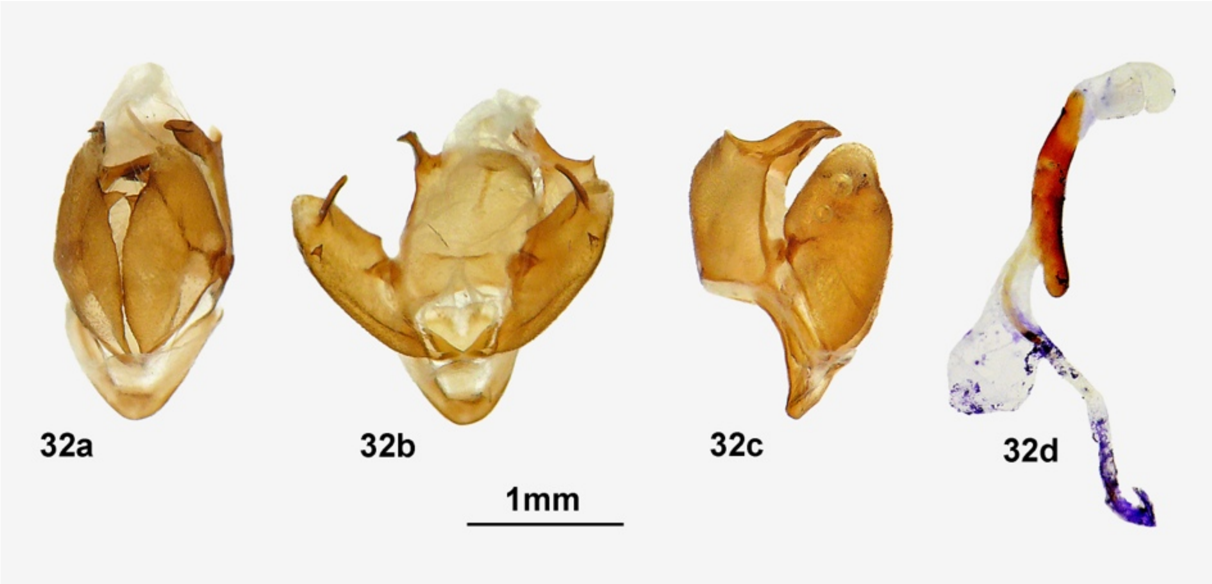


Fig. **31**-**32**. *Tamphana paranensis* **n**. **sp**., holotype ♂.

31. **a**. Upperside. **b**. Underside (labels not to scale). **32** Genitalia. **a**. Ventral view, aedeagus removed. **b**. Ventral view with valvae opened. **c**. Lateral view. **d**. Aedeagus.

formula 0-2-2. Forewing upperside mahogany brown (70,34,0), a faint slightly paler brown antemedial line, a medial black brown line, postmedial line only represented by black dots at intersection with veins, a dark chocolate brown transverse patch below apex. Termen slightly concave below apex, then convex down to tornus.

Hindwing upperside uniform clay brown (135,88,46), with a patch of chocolate brown hair-like scales near tornus.

Fore- and hindwing underside ochre brown with darker medial and postmedial lines, faint on forewing, well visible on hindwing. Discal spots absent.

Abdomen upperside chocolate brown; underside proximally ivory, distally chocolate brown.

Genitalia ♂ (Fig. 32a, 32b, 32c & 32d). The genitalia of this species show some similarity to those of *T. praecipua*. Uncus membranous, short and rectangular with pointed sclerotized socii. Valvae oval shaped with a spine-like process arising dorsally about two third from the apex, with a second tiny triangular process arising below the dorsal one. Aedeagus as long as valvae and slightly curved.

Female. – Unknown.

Immature stages. – Unknown.

Geographic distribution. – Brazil: Minas Gerais and Paraná

Etymology. – The name is derived from the Brazilian state of Paraná, the origin of the holotype. A noun in the nominative singular standing in apposition to the generic name.

Discussion. – The bipectinate antennae, the ivory ventral face of the abdomen, the tibial spur formula 0-2-2, and the hairy patch on the hindwing anal margin lead us to classify this species in genus *Tamphana*. The configuration of the male genitalia, with a membranous uncus and socii, the spiny process arising from inside the valves, shows similarities with genitalia of *T. praecipua*. No DNA barcoding is yet available for this species, nor for *T. praecipua* and *T. inferna*. When these do become available, then we may have confirmation of their hypothesized phylogenetic affinity and whether or not they belong to a single species-group, or even a separate genus.

Tuyvae Orlandin Piovesan & Carneiro, 2024

Tamphanoides Piñas, 2004 ***nomen nudum*** (see remarks)

Type Species. – *Parathyris orion* Dognin, 1916 as designated by Orlandin *et al*., 2024.

Included species. – *Tuyvae orion* (Dognin, 1916), *T. maoma* (Schaus, 1920).

Diagnosis. – Relatively small sized moths (ca. 30 mm wingspan), antennae bipectinate to the tip, legs with thick vestiture, venation with only three Rs veins, M2 closer to M1 than to M3 on both fore- and hindwing, tibial spurs formula 0-2-4, frenulum present. Forewing with a thick double antemedial line, almost straight, a diagnostic character being a small lobe on the inner margin of the forewing at the end of the antemedial lines. A small circular white spot at extremity of forewing discal cell, adjacent to the distal antemedial line.

Male genitalia with a strong bifid or trifid uncus, socii absent, sacculus heavily sclerotized, of complex shape, with multiple spines. Gnathos membranous or sclerotized. Aedeagus rather simple, without cornuti.

Redescription

Male

Head. – Small, ochre- or clay-brown. Antennae bipectinate to tip.

Legs (Fig. 34a, 34b & 34c). – Prothoracic coxa thick, approximately half length of femur, epiphysis 2/3 length of tibia. Tibial spurs formula: 0-2-4.

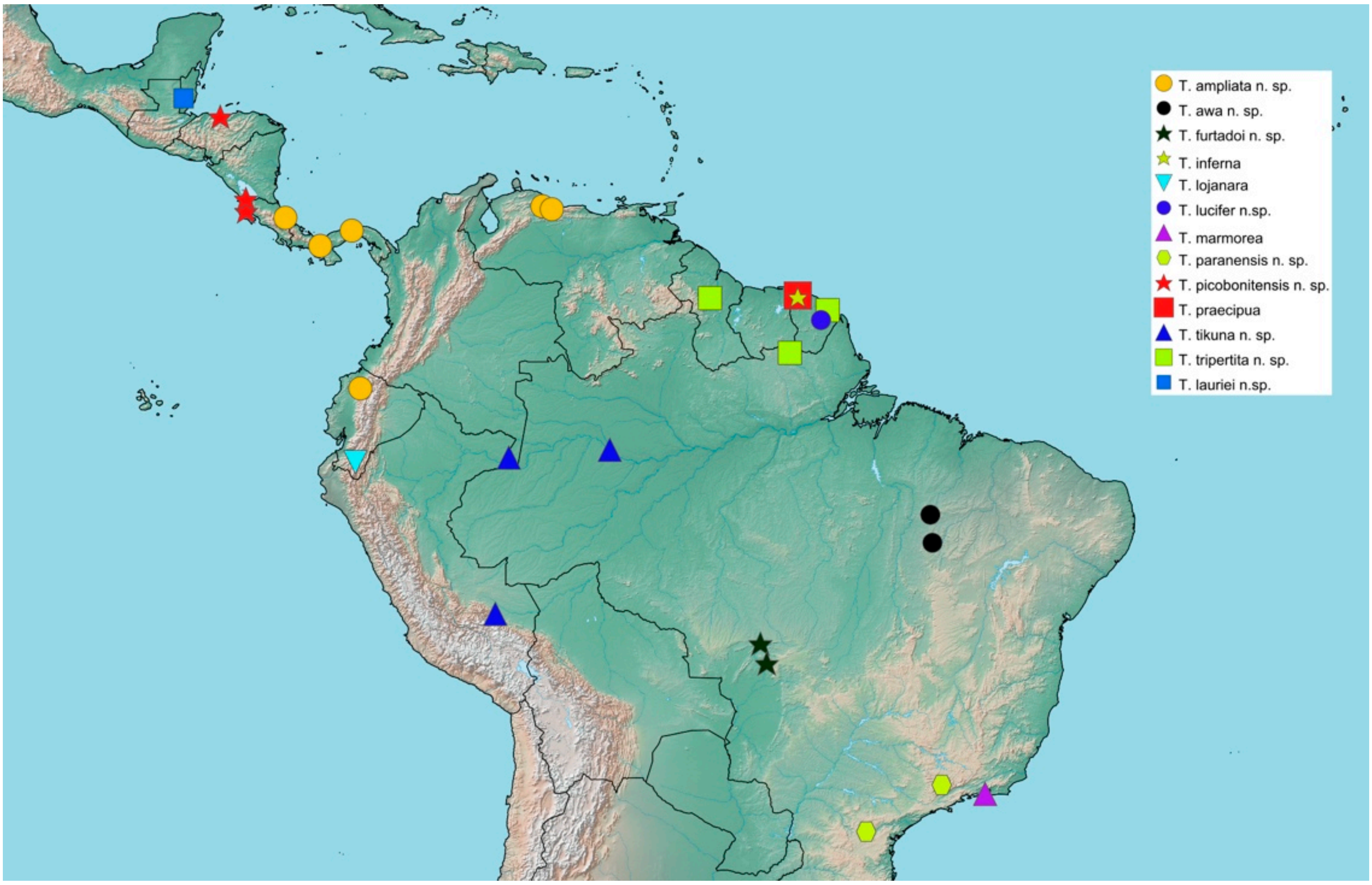


Fig. 33. Geographic distribution of *Tamphana* species.

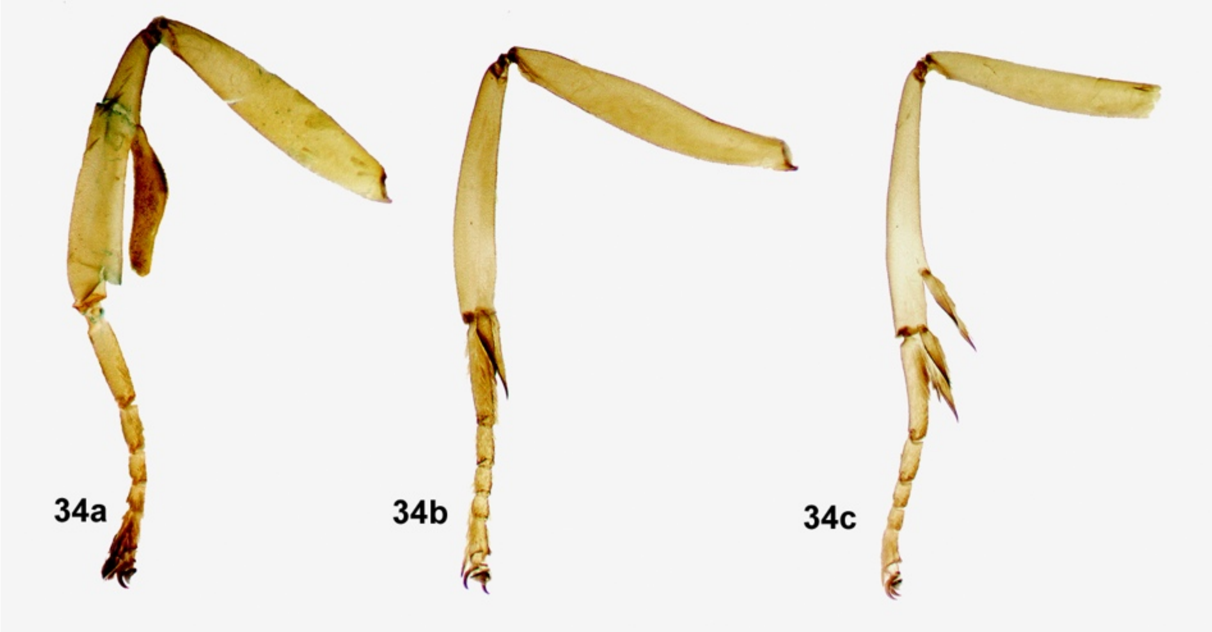


Fig. **34**. *Tuyvae* legs (based on a male *Tuyvae orion* from French Guiana). **a**. Prothoracic leg. **b**. Mesothoracic leg. **c**. Metathoracic leg.

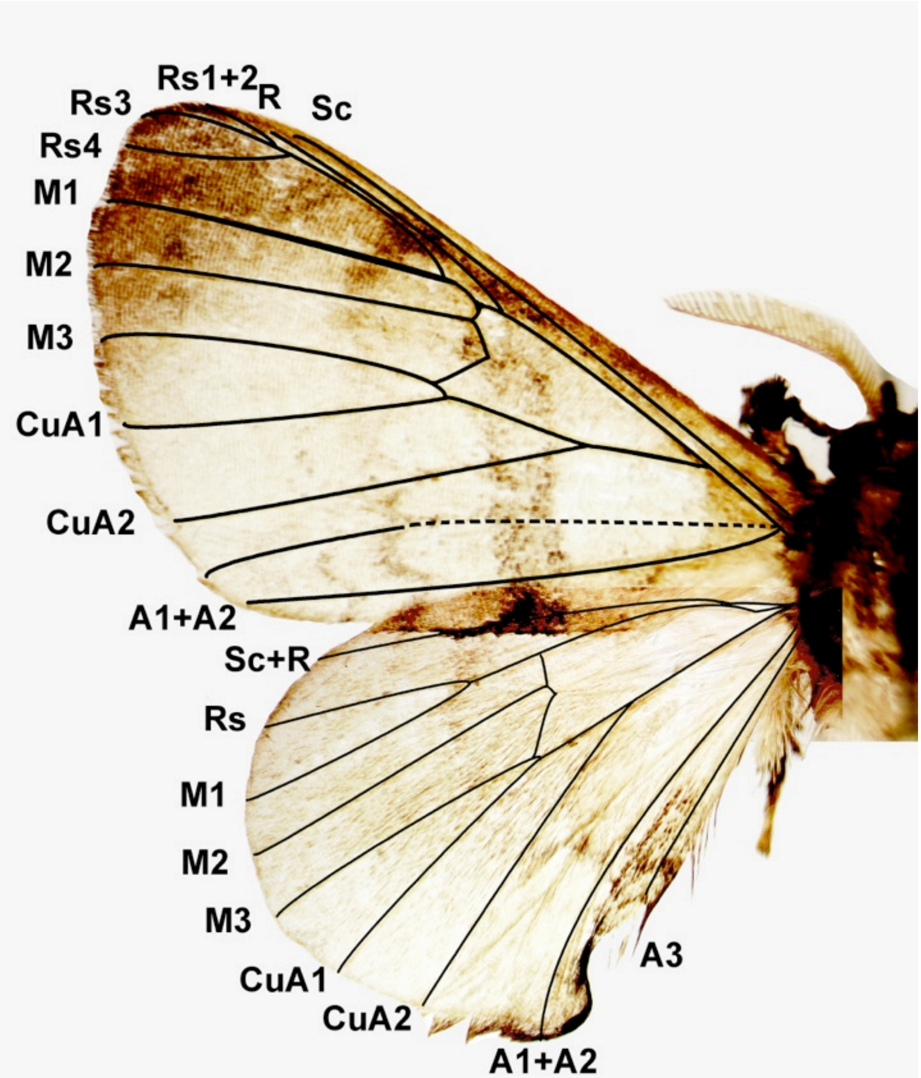


Fig. **35**. *Tuyvae* venation based on a male *T. orion* (Dognin, 1916) from French Guiana.

Forewing upperside. – Subtriangular, 10 to 15 mm length, termen regularly convex. Ground colour of various shades of brown, sometimes with darker areas, particularly near apex. Small whitish dot at upper end of discal cell sometimes present. Double parallel thick antemedial line more or less complete, and faint, zigzagged, postmedial lines. A characteristic small lobe on the inner margin at the end of the antemedial lines. Three brownish aligned spots below apex.

Forewing underside. – Uniform brown colour, slightly paler than upperside. Zigzagged, postmedial lines somewhat more visible than on upperside.

Hindwing upperside. – Uniform brown colour. A patch of thick, slightly longer and darker scales from mid length to apex of anal margin.

Hindwing underside. – Uniform paler beige colour with a pair of zigzagged darker lines, not always evident, and a sparse speckling of dark scales.

Venation (Fig. 35). – As illustrated for *Apatelodes torrefacta* by Franclemont (1973: fig. 3). M2 closer to M1 in both forewing and hindwing (equidistant from M1 and M3 on forewing for *Tamphana*). Only three Rs veins are present on forewing, with the interpretation that Rs1 and Rs2 are fused.

Abdomen. – Abdomen thin, longer than wings length, and generally with evident anal tuft.

Genitalia. – Uncus well developed, with either two or three sclerotized apical projections. Socii absent. Valvae elongate, with rounded apex. Aedeagus mostly simple, without cornuti.

Female. – Unknown.

Immature stages. – Unknown.

Remarks. – According to Thöny & Piñas (2015, 2017), all names proposed by Piñas are unavailable and must be regarded as *nomina nuda* since they do not satisfy the Article 13.1.1 of the ICZN for a taxonomically available name (e.g. no description is provided) (see also St Laurent *et al.* 2017).

Tuyvae orion (Dognin, 1916)

(Fig. 36a, 36b, 37a, 37b & 37c)

Parathyris orion Dognin, 1916: 9-10
Tamphana orion; Schaus (1929: 693)
Tamphana orion; Becker (1996: 16)
Tamphana orion; Kitching *et al.* (2018: suppl. material 1)
Tuyvae orion; Orlandin, Piovesan & Carneiro (2024: 29)

Diagnosis. – Ground colour light ochre with two brown, parallel, relatively thick and straight antemedial lines from inner margin to costa, the distal becoming weak towards the costal margin. A white spot at the extremity of the cell, in contact with the distal antemedial line. The two parallel, zigzagged and faint postmedial lines on

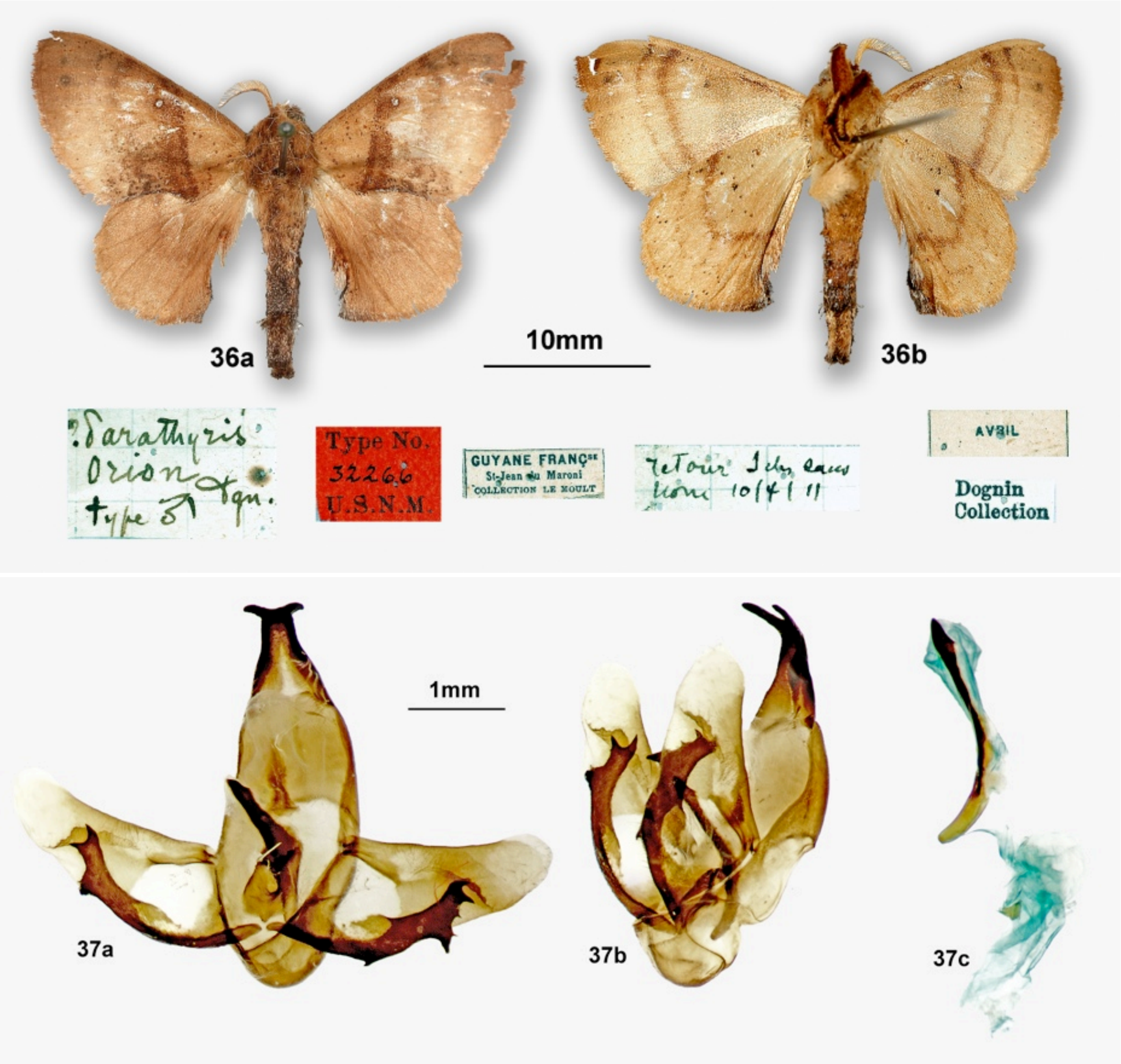

36a
10mm
36b
?Parathyris Orion type ♂ Dgn.
Type No. 32266 U.S.N.M.
GUYANE FRANÇse St-Jean du Maroni COLLECTION LE MOULT
retour 10/4/11
AVRIL
Dognin Collection
1mm
37a
37b
37c

Fig. 36-37. *Tuyvae orion* lectotype ♂.

36. **a**. Upperside. **b**. Underside (Photographs D. Herbin, courtesy USNM, labels not to scale). **37**. Genitalia ref. H. 1656 (French Guiana, Piste Coralie). **a**. Lateral view. **b**. Ventral view. **c**. Aedeagus.

forewing are closer to the antemedial lines than in the other species of the genus. In the male genitalia, the uncus is strongly sclerotized and bifid, the sacculi are also heavily sclerotized with a series of spines along their length and at the apex; the aedeagus is thin, evenly curved, without cornuti and showing heavy sclerotization from before the middle to apex.

Lectotype (**here designated**), ♂, bearing the following labels: *Parathyris orion* Dgn type ♂, Guyane Françse, St Jean du Maroni, collection Le Moult − Type N° 32266 U.S.N.M. − avril − retour Sch[au]s sans nom 10/4/11 − Dognin Collection − *In* USNM (examined).

Additional material examined (**10** ♂)

- **1** ♂, French Guiana, Route forestière de la Montagne de Fer pk 25/26, 23.II.2009, *leg*. B. Hermier, n° 23484. *In* CBH.
- **1** ♂, French Guiana, Crique Ekini Carbet Biren, 3°54'N 52°28'W, 25-28.VIII. 2006, *leg*. F. Bénéluz, Hermier n° 22366. *In* CBH.
- **1** ♂, French Guiana, N2 pk79, 4°24'N 52°18'30"W, 2.XII.1994, *leg*. B. Hermier, n° 6473. *In* CBH.
- **1** ♂, French Guiana, Piste Coralie, 4°29'07.43"N 52°23'49.40"W, 40 m, 12.X. 2013, *leg*. D. Herbin – Genitalia prep. D. Herbin ref H. 1656. *In* CDH.
- **1** ♂, French Guiana, Piste Coralie, 4°29'07.43"N 52°23'49.40"W, 40 m, 16.XI. 2013, *leg*. D. Herbin. *In* CDH.
- **1** ♂, French Guiana, Piste Coralie, 4°29'07.43"N 52°23'49.40"W, 40 m, 30.XI. 2013, *leg*. D. Herbin – Genitalia prep. D. Herbin ref H. 1508 – Barcode Bc-Her4808. *In* CDH.
- **2** ♂, French Guiana, Saint Jean du Maroni, collection Le Moult – *In* NHMUK.
- **1** ♂, Brazil, Pará (A.M. Moss), NHMUK 014200565, prep. genitalia A. Giusti ref. NHMUK010402681 – *In* NHMUK.
- **1** ♂, Peru, [Loreto], Putumayo, Río Ampiyacu, Joicey Coll., NHMUK 014200564, prep. genitalia A. Giusti ref. NHMUK010402680 – *In* NHMUK.

Redescription

Male (Fig. 36a & 36b).

Forewing length: 14 mm; wingspan: 29mm. Antennae bipectinate. Head, collar and thorax ochre brown (140,93,52). Abdomen proximal half ochre brown, distal half darker terra brown (77,59,47). Forewing with termen slightly convex, inner margin expanded at antemedial line. Ground colour ochre yellow (191,148,98), with two fawn brown, slightly convex antemedial lines, a small whitish spot at upper end of cell. Two lunate postmedial lines, darker than the ground, but partly missing. Below apex three brownish aligned spots. Some speckling of darker brown scales.
Hindwing upperside brown beige (189,143,96) with barely visible lines, mainly by transparency from underside.
Forewing underside light ivory with darker brown beige (165,121,55) area near apex and termen, two convex brown beige postmedial lines. A tiny black dot at upper end of cell. Hindwing underside light ivory, two brown beige postmedial lines, distal one weakly contrasting, and a small black dot at extremity of cell. Sparse speckling of black scales.

Genitalia ♂ (Fig. 37a, 37b & 37c). Uncus bifid, saccus wide and rounded, sacculus 2/3 length of valva, asymmetric with multiple pointed projections on its dorsal, ventral and distal portions. Aedeagus thin, evenly curved, almost as long as valva.

Female. – Unknown.

Immature stages. – Unknown.

Geographic distribution. – French Guiana, Brazil (Pará) and Peru (Loreto) at low elevation in Amazonian basin.

Discussion. – Dognin (1916) described *Parathyris orion* based on two specimens, as indicated in the original description. The specimen in USNM, figured in 36 and bearing a red label Type n° 32266 U.S.N.M., is **here designated as lectotype**. The other specimen with a manuscript label stating "cotype" by Dognin is actually not conspecific, but a specimen of *Tuyvae maoma*. This was already pointed out by Schaus (1929). One specimen from Brazil, Pará and another one from Peru, Loreto in NHMUK were dissected and have the same genitalia, and are thus identified as *T. orion*.

Tuyvae douglasboyesi Giusti, Herbin & Mielke **n**. **sp**.

(Fig. 38a, 38b, 39a, 39b & 39c)

ZooBank : https://zoobank.org/37453E75-48A9-4E5F-89D4-320FC3F16517

Diagnosis. – *Tuyvae douglasboyesi* **n**. **sp**. is very similar to *T. orion*, with two complete parallel thick antemedial lines and weakly visible postmedial lines, but the white spot at extremity of the cell is unclear. Main differences are found in the genitalia. As in *T. orion* the bifid arms of the uncus bend forward, but in *T. douglasboyesi* **n**. **sp**. they also bend slightly upwards. The sacculi are symmetrical, only half the length of valva, and show fewer pointed projections on only their dorsal portions, compared to the sacculi of *T. orion*. Moreover the aedeagus has an apical spine in *T. douglasboyesi* **n**. **sp**.

Holotype, ♂, bearing the following labels: Holotype ♂, *Tuyvae douglasboyesi* Giusti, Herbin & Mielke. 2024, − Ob. Rio Negro, Ost Colombia, 800 m, Coll. Fassl.− Joicey Coll., Brit. Mus. 1925-157 − NHMUK 014200560 – prep. gen. NHMUK010402680 – *In* NHMUK.

Description

Male (Fig. 38a & 38b)

Forewing length: 14 mm; wingspan: 29mm. Head, collar and thorax ochre brown (140,93,52). Abdomen proximal half ochre brown, distal half darker terra brown (77,59,47). Forewing with termen slightly convex, and inner margin expanded at antemedial line. Ground colour ochre yellow (191,148,98), with two fawn brown, almost straight, antemedial lines, whitish spot at upper end of cell is obscure. Postmedial line, lunate, darker than the ground, double but partly missing. Below apex three brownish aligned spots. Forewing speckled with darker brown scales.
Hindwing upperside brown beige (189,143,96) with barely visible lines, mainly by transparency from underside.
Forewing underside light ivory with darker brown beige (165,121,55) area near apex and termen, two convex brown beige postmedial lines. A tiny black dot at upper end of cell. Hindwing underside light ivory, with two barely visible brown postmedial lines, darker area at apex and sparse speckling of black scales.

Genitalia ♂ (Fig. 39a, 39b & 39c). Uncus bifid, sacculi symmetrical, half the length of valva, and with pointed projections on dorsal portion. Aedeagus with an apical spine.

Female. – Unknown.

Immature stages. – Unknown.

Geographic distribution. – Eastern Colombia.

Etymology. – This species is dedicated to a young and enthusiast British entomologist, Douglas Boyes (see home page douglasboyes.co.uk/index.htm, last accessed 29.III.2022), who left us too early. A noun in the genitive case.

Tuyvae maoma (Schaus, 1920)

(Fig. 40a, 40b, 41a, 41b & 41c)

Tamphana maoma Schaus, 1920: 135-136
Tamphana maoma; Schaus (1929: 692-693)
Tamphana maoma; Becker (1996: 16)
Tamphanoides maoma; Piñas (2008: fig. 345); *nomen nudum*
Tamphana maoma; Kitching *et al*. (2018: suppl. material 1)
Tuyvae maoma; Orlandin, Piovesan & Carneiro, (2024: 37)

Diagnosis. – *Tuyvae maoma* is similar to *T. orion.* It can be distinguished by a more uniform and darker brown ground colour, an incomplete thick antemedial line of the forewing, not reaching the costa, whereas this is formed by two complete lines reaching the costa in *T. orion*. On the hindwing underside, the two parallel postmedial lines are wavier in *T. maoma*, the proximal one darker and the distal

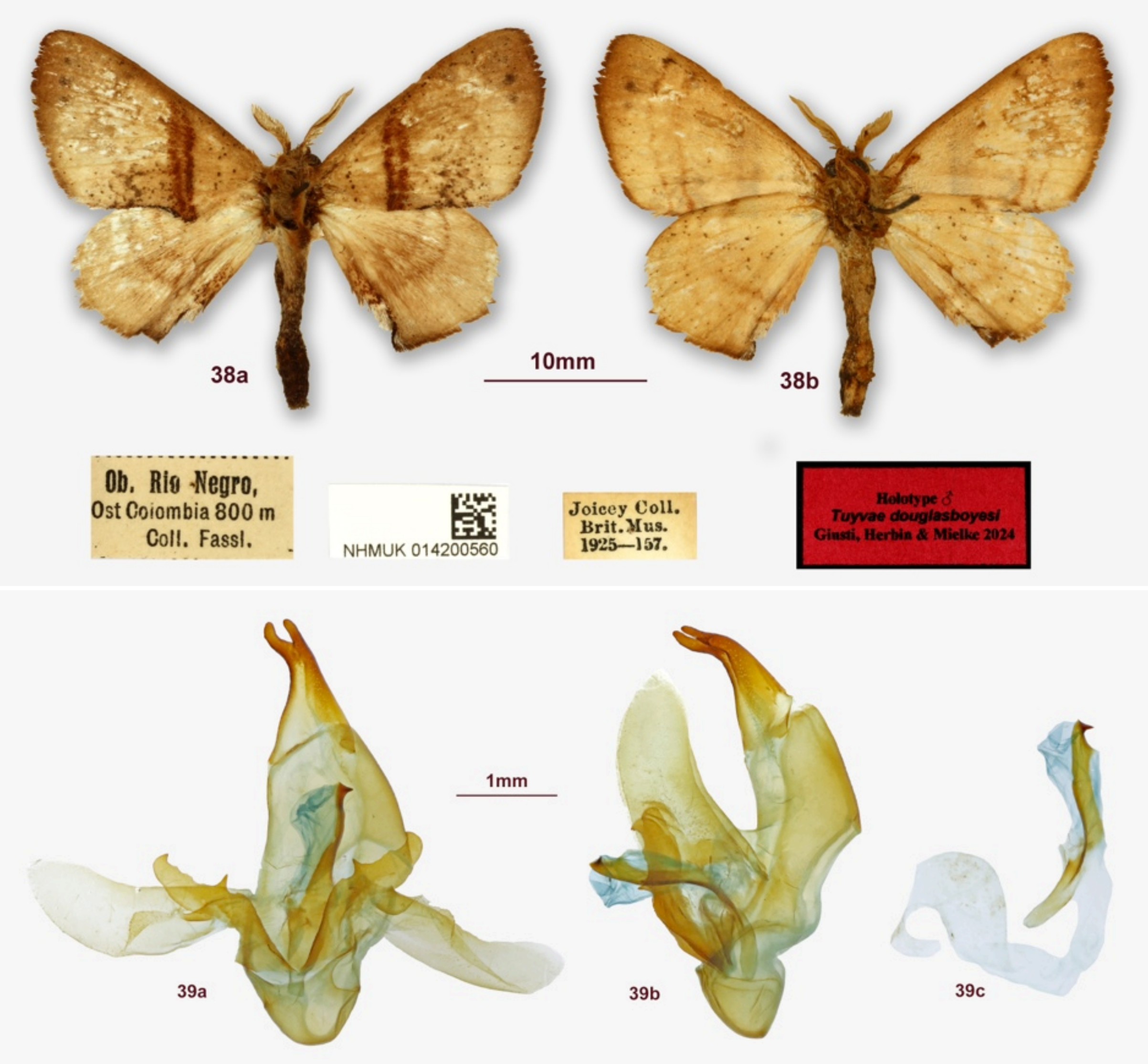


Fig. 38-39. *Tuyvae douglasboyesi* **n. sp.** holotype ♂.

38. **a**. Upperside. **b**. Underside (Photographs A. Giusti, courtesy NHMUK, labels not to scale). **39**. Genitalia ref. NHMUK010402680. **a**. Ventral view. **b**. Lateral view. **c**. Aedeagus.

one weakly marked in *T. orion*, the reverse for *T. maoma*. The male genitalia are extremely different with a wider uncus and a central hook in *T. maoma,* while *T. orion* uncus is narrow and ends with a bifid apex. This can be verified without preparation of genitalia, just by brushing the abdomen tip and examining the uncus under binocular.

Holotype, ♂, bearing the following labels: *Tamphana maoma* type Schs. – St. Jean, Maroni, F. Guiana – Type n° 22461 U.S.N.M. – sp. fig. – Collection WmSchaus. *In* USNM (examined).

Additional material examined (**8** ♂)

- **1** ♂, French Guiana, D6 pk 41.5, 4°31'30"N 52°7'W, 25.IX.1998, *leg*. B. Hermier, n° 15333. *In* CBH.
- **1** ♂, French Guiana, Route forestière de Bélizon, Montagne Tortue pk 24.7, 15.X. 1999, *leg*. B. Hermier, n° 16863. *In* CBH.
- **1** ♂, French Guiana, Roura à Kaw PK 6.8, 4°41'17.03"N 52°18'23.87"W, 217 m, 14.X.2015, *leg*. D. Herbin – Genitalia prep. D. Herbin ref H. 1509 – Barcode Bc-Her5663. *In* CDH.
- **1** ♂, French Guiana, Saint Jean du Maroni, collection Le Moult – avril – not in Wash'ton Schs 2.14 – retour Schs sans nom 10/4/11 – *Parathyris orion* Dgn cotype – DOGNIN Collection. *In* USNM.
- **3** ♂, French Guiana, Saint Jean du Maroni, collection Le Moult. (QR codes NHMUK014200561, NHMUK014200562, NHMUK014200563). *In* NHMUK.
- **1** ♂, French Guiana, Nouragues research station, 4.098N 52.68W, 08.IX. 2010, leg. C. Lopez Vaamonde – Barcode LNOUD029-10. *In* MNHN.

Redescription

Male (Fig. 40a & 40b)

Forewing length: 15 mm; wingspan: 30 mm.
Antennae bipectinate to the tip. Head, collar and thorax clay brown (128,85,46). Abdomen clay brown in proximal half, black brown (33,18,10) in distal half.
Forewing upperside uniformly brown beige (160,118,79), termen slightly convex, inner margin expanded at antemedial line. Antemedial line thick, darker brown, visible only on basal half. Two postmedial lines, brown, lunate, barely visible. A row of three brown spots below apex.
Hindwing upperside uniformly brown beige (174,134,94) without marking.
Forewing underside beige (185,160,128) with two brownish postmedial lines, a row of three dark brown spots below apex, fringe and marginal area nut brown (93,46,8).
Hindwing underside beige with two, slightly darker brown, lunate postmedial lines. Darker area at apex and a speckling of blackish scales.

Genitalia ♂ (Fig. 41a, 41b & 41c). Uncus wide, twice longer than width, apex trifid with a central acute hook, gnathos as two unfused arms. Saccus wide, rounded. Sacculus terminated with a strong spine and a secondary perpendicular spine. Aedeagus straight, quite short, cornutus absent.

Female. – Unknown.

Immature stages. – Unknown.

Geographic distribution. – French Guiana.

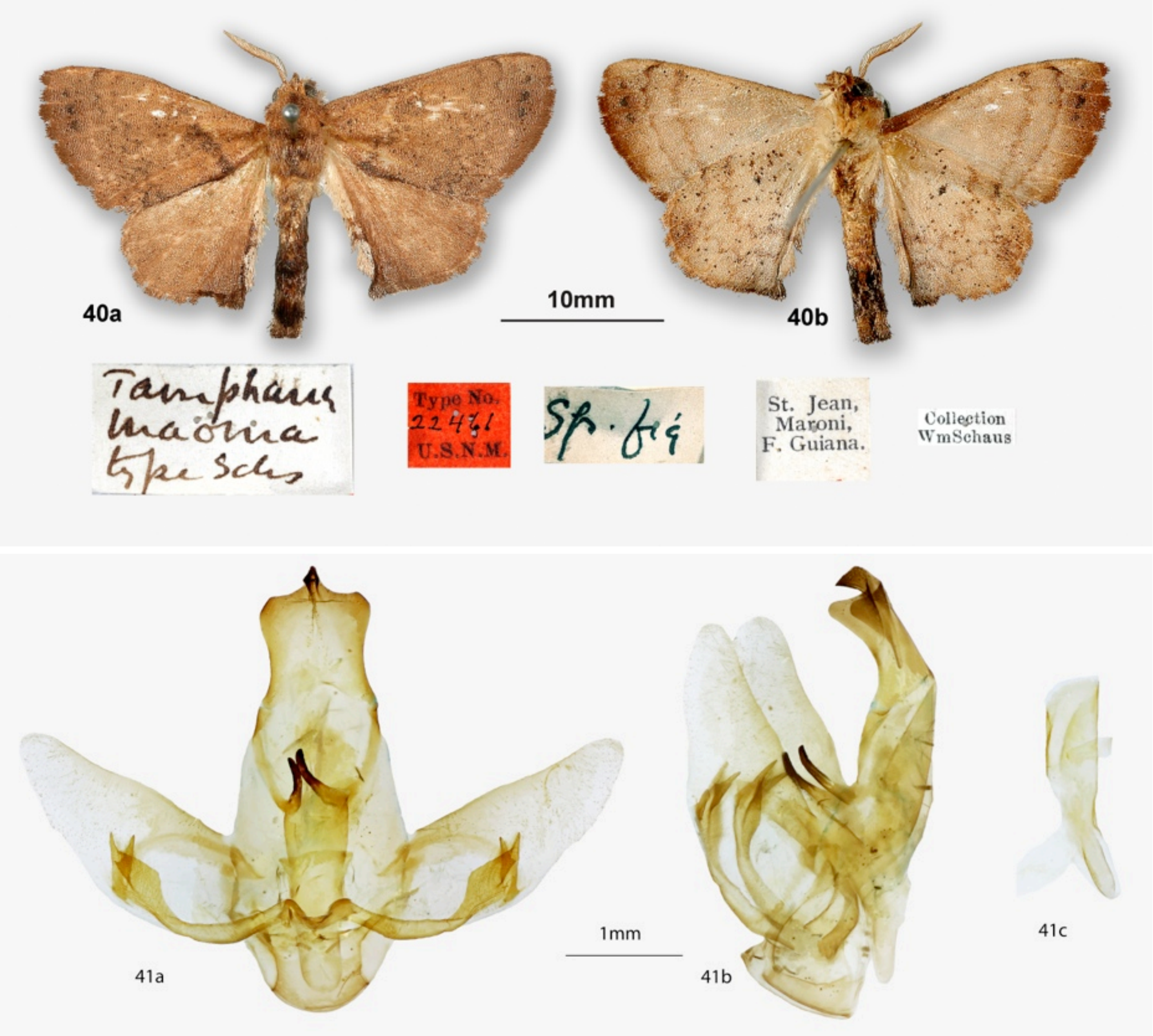


Fig. 40-41. *Tuyvae maoma* holotype ♂.

40. **a**. Upperside. **b**. Underside (Photographs D. Herbin, courtesy USNM, labels not to scale). **41**. Genitalia ref. NHMUK010402685 (specimen with QR code NHMUK014200561, French Guiana, Saint Jean du Maroni). **a**. Ventral view, aedeagus in place. **b**. Lateral view, aedeagus in place. **c**. Aedeagus.

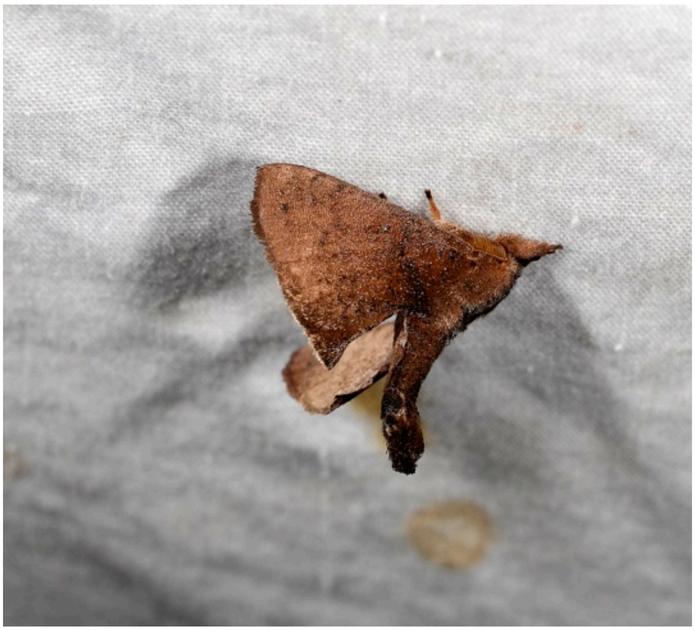


Fig. 42. *Tuyvae maoma* ♂ (photograph D. Herbin in French Guiana). Resting position at light trap showing the upwardly curved abdomen and the wings directed downwards in "roof" attitude. Note the protruding patch of thick, slightly longer and darker scales on the anal margin of hindwings contributing to the mimicry with a small piece of wood.

Discussion. – Piñas (2008: Fig. 345) figured a specimen from Ecuador, Oriente, likely related to *T. orion* (mentioned as *Tamphanoides maoma* Piñas *nomen nudum*, even though the complete two parallel antemedial lines clearly indicate it should be related to *T. orion*), but as the record comes from Ecuador, it is unclear whether it should be assigned to this species. Further investigation is needed when material becomes available. The resting position of *T. maoma* at a light trap in French Guiana (fig. 42) shows the abdomen curved upwards, and the wings in a "roof" position. The barcode divergence from *T. orion* is about 9 % (Fig. 45).

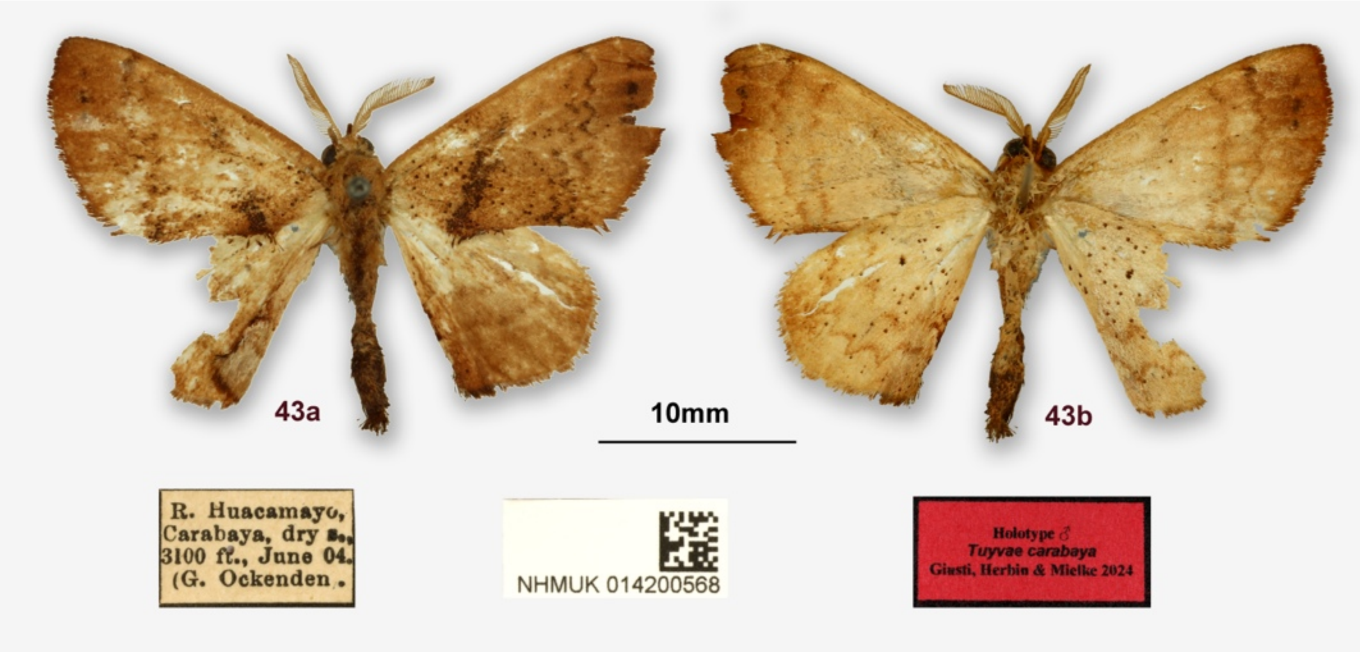
Tuyvae carabaya Giusti, Herbin & Mielke **n**. **sp**.

(Fig. 43a, 43b, 44a, 44b & 44c)

ZooBank : https://zoobank.org/AA683BC1-2707-4F64-A917-77BF82E8ED47

Diagnosis. – A similar species to *T. maoma*, that can be discriminated by male genitalia: uncus narrower than the one of *T. maoma*, with longer and more pointed side processes. The sacculi are shorter, less than half of the length of valvae, whereas these are longer in *T. maoma*. The apex of the sacculus is less expanded and shows a spiny tip and two lateral small spines.

Holotype, ♂, bearing the following labels: *Tuyvae carabaya* Giusti, Herbin & Mielke 2024. – [Peru, Puno], R. Huacamayo, Carabaya, dry s., 3100 ft, June 04 (G. Ockenden. – NHMUK 014200568. – prep. genitalia A. Giusti ref. NHMUK010402683 – *In* NHMUK.



R. Huacamayo,
Carabaya, dry s.,
3100 ft., June 04.
(G. Ockenden.

NHMUK 014200568

Holotype ♂
Tuyvae carabaya
Giusti, Herbin & Mielke 2024

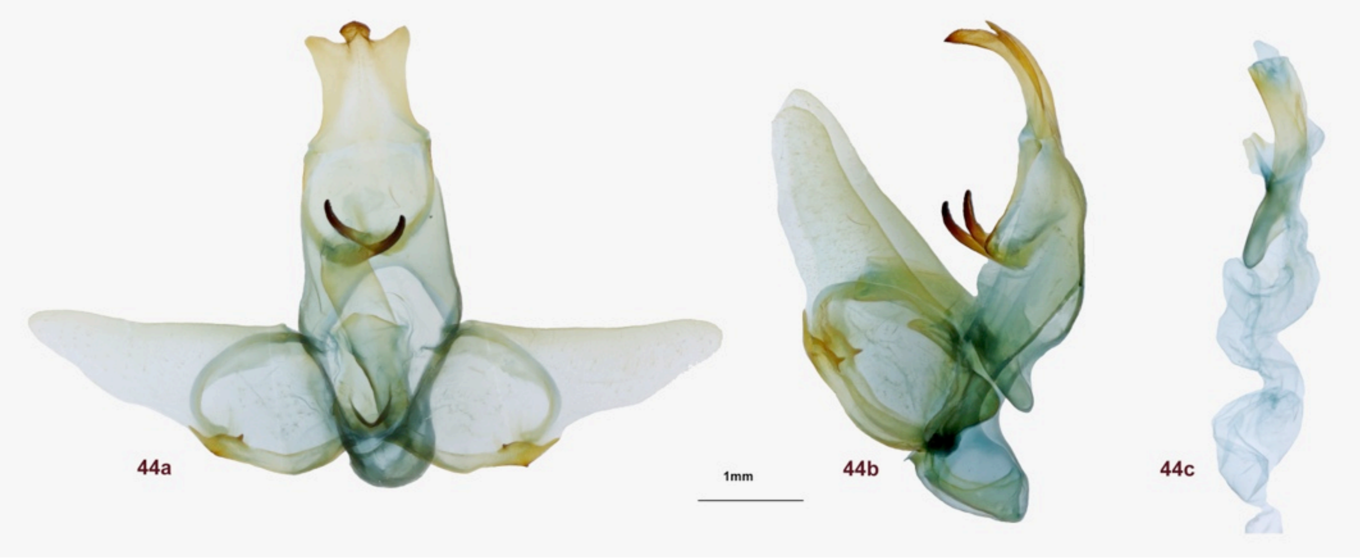


Fig. 43-44. *Tuyvae carabaya* **n. sp**. holotype ♂.

43. **a**. Upperside. **b**. Underside (Photographs A. Giusti, courtesy NHMUK, labels not to scale). **44**. Genitalia ref. NHMUK010402683. **a**. Ventral view, aedeagus in situ. **b**. Lateral view, aedeagus in situ. **c**. Aedeagus.

Description

Male (Fig. 43a & 43b).

Forewing length: 15 mm; wingspan: 30 mm.
Habitus similar to *T. maoma*, but slightly paler overall.

Genitalia ♂ (Fig. 44a, 44b & 44c). Uncus wide with a central acute beak, two separate gnathos arms. Saccus wide, rounded. Sacculus terminating with a strong spine, and two lateral smaller spines. Aedeagus quite short (half the length of the valva).

Female. – Unknown.

Immature stages. – Unknown.

Geographic distribution. – Known only from the holotype locality: Peru, Carabaya, Rio Huacamayo at medium elevation.

Etymology. – This species is named for the typical locality, the cordillera of Carabaya. A noun in the nominative singular standing in apposition to the generic name.

Conclusion and perspectives

The classification of *Tamphana* in Apatelodidae family, as originally proposed by Minet (1994), is confirmed on the basis of venation and the typically setose appearance of the caterpillars. A singular character within the family is the tibial spurs formula: 0-2-2 for *Tamphana*, whereas Apatelodidae generally exhibits a 0-2-4 formula.

From the geographical distribution of the genus, presented in fig. 33, observation is made that four different species are found in French Guiana only. This likely indicates a high potential for undiscovered species throughout the range of this genus, from Mexico to South East Brazil. The *T. marmorea* group revealed to be a cryptic group with many very similar species for which study of genitalia demonstrated unexpected, conspicuous and marked differences. This, together with DNA barcode analysis allowed us to disentangle this complex group.

Part of the species that were initially included within *Tamphana* were separated in a distinct genus *Tuyvae*, recently described. Applying the same rationale as above, with two species found in

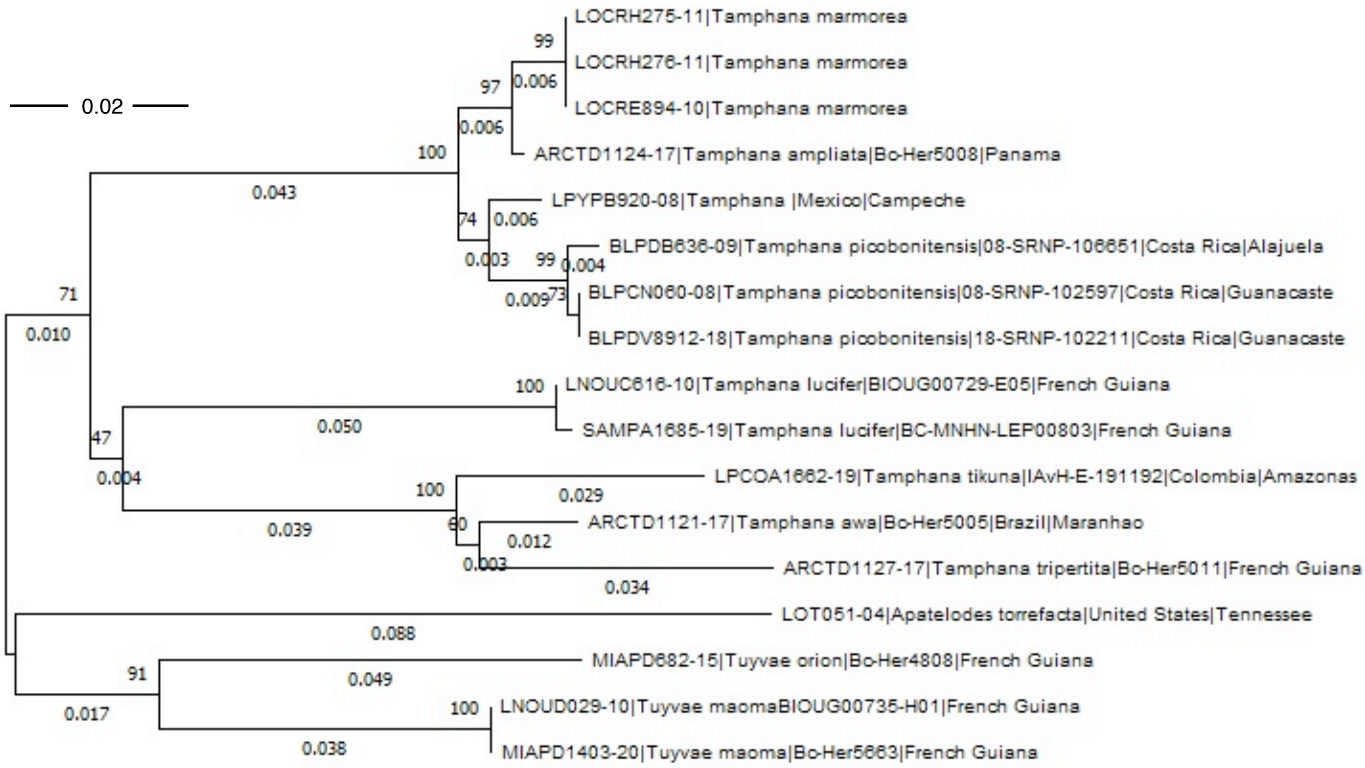

0.02
LOCRH275-11|Tamphana marmorea
99
LOCRH276-11|Tamphana marmorea
97
0.006
LOCRE894-10|Tamphana marmorea
0.006
100
ARCTD1124-17|Tamphana ampliata|Bo-Her5008|Panama
0.043
LPYPB920-08|Tamphana |Mexico|Campeche
74
0.006
BLPDB636-09|Tamphana picobonitensis|08-SRNP-106651|Costa Rica|Alajuela
0.003
99
0.004
71
0.009
73
BLPCN060-08|Tamphana picobonitensis|08-SRNP-102597|Costa Rica|Guanacaste
0.010
BLPDV8912-18|Tamphana picobonitensis|18-SRNP-102211|Costa Rica|Guanacaste
100
LNOUC616-10|Tamphana lucifer|BIOUG00729-E05|French Guiana
0.050
47
SAMPA1685-19|Tamphana lucifer|BC-MNHN-LEP00803|French Guiana
0.004
100
LPCOA1662-19|Tamphana tikuna|IAvH-E-191192|Colombia|Amazonas
0.029
0.039
60
ARCTD1121-17|Tamphana awa|Bo-Her5005|Brazil|Maranhao
0.012
0.003
ARCTD1127-17|Tamphana tripertita|Bo-Her5011|French Guiana
0.034
LOT051-04|Apatelodes torrefacta|United States|Tennessee
0.088
MIAPD682-15|Tuyvae orion|Bo-Her4808|French Guiana
91
0.049
0.017
100
LNOUD029-10|Tuyvae maomaBIOUG00735-H01|French Guiana
0.038
MIAPD1403-20|Tuyvae maoma|Bo-Her5663|French Guiana

Fig. **45**. Phylogenetic tree of *Tamphana* and *Tuyvae*, with neighbour-joining method. The percentage of replicate trees in which the associated taxa clustered together in the bootstrap test (1000 replicates) are shown next to the branches. The branches lengths (below the branches) correspond to the evolutionary distances. All sequences have been deposited in BOLD. Specimens from Costa Rica, Limon were barcoded by and in collection Bo Sullivan, specimens from Costa Rica Guanacaste and Alajuela were barcoded by Dan Janzen and deposited in USNM. Access to these sequences courtesy of Bo Sullivan and Daniel Janzen.

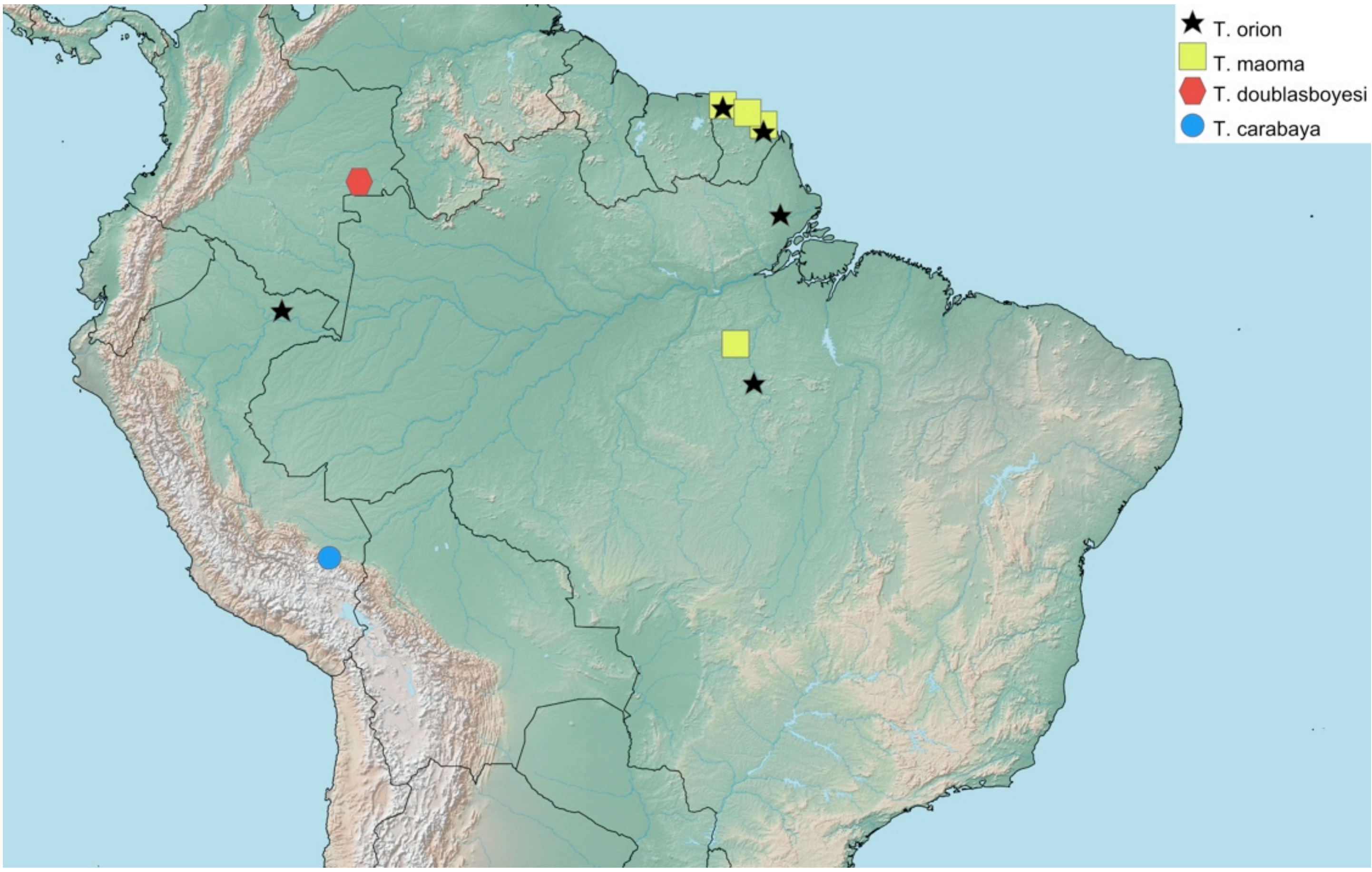


Fig. **46**. Geographic distribution of various *Tuyvae* species.

French Guiana only, and only two new species discovered from the Andean countries, here again a high potential for undiscovered species exists, for which further investigation is encouraged.

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Jerry and Linda Harrison (Panama) provided photographs of a live *Tamphana ampliata* **n. sp**. in Panama.

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Article proofreading. – DH, AG & CM

Bibliographic work. – DH

Material study. – DH, AG & CM

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Résumé

Cumming R. T., Engel M. S., Lian Z. & Ulitzka M. R., 2024. – Révision taxonomique des genres *Tamphana* Schaus et *Tuyvae* Orlandin, Piovesan & Carneiro avec description de onze nouvelles espèces (Lepidoptera, Apatelodidae). *Faunitaxys*, 12(61): 1 – 31.

Le genre *Tamphana* Schaus, 1892 est révisé. Le transfert de *Tamphana* des Bombycidae vers les Apatelodidae est confirmé. Cette étude, basée sur l'examen de l'habitus, des genitalia et de barcodes ADN conduit à séparer les diverses espèces de *Tamphana* actuellement connues en deux genres distincts. L'examen des genitalia de specimens supposés appartenir à l'espèce *Tamphana marmorea* Schaus, 1892 a révélé de très bons caractères diagnostiques conduisant à la description de neuf nouvelles espèces : *T. awa* **n. sp.** du Brésil, Maranhão, *T. ampliata* **n. sp.** du Costa Rica, panama, Venezuela et Equateur, *T. picobonitensis* **n. sp.** du Honduras et du Costa Rica, *T. furtadoi* **n. sp.** du Brésil Mato Grosso, *T. lauriei* **n. sp.** du Belize, *T. lucifer* **n. sp.** de Guyane Française, *T. paranensis* **n. sp.** du Brésil (Minas Gerais et Paraná), *T. tikuna* **n. sp.** de Colombie, Pérou et Brésil (Amazonas), *T. tripertita* **n. sp.** de Guyane Française. Les imagos et genitalia de ces nouvelles espèces sont illustrés. Un lectotype pour *Tamphana marmorea* est désigné et figuré. Dans le genre *Tuyvae* Orlandin, Piovesan & Carneiro, 2024 récemment publié, aux deux espèces déjà décrites: *Tuyvae maoma* (Schaus, 1920) et *Tuyvae orion* (Dognin, 1916), deux nouvelles espèces y sont ajoutées : *Tuyvae douglasboyesi* **n. sp.** de Colombie et *Tuyvae carabaya* **n. sp.** du Pérou. Un lectotype est désigné et figuré pour *Tuyvae orion*.

Mots-clés. – Lepidoptera, Apatelodidae, *Tamphana*, *Tuyvae*, taxonomie, description, nouvelle espèce, biodiversité, Néotropical, Brésil, Colombie, Costa Rica, Equateur, Guyane Française, Panama, Pérou.

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SOMMAIRE

Révision taxonomique des genres *Tamphana* Schaus et *Tuyvae* Orlandin, Piovesan & Carneiro avec description de onze nouvelles espèces (Lepidoptera, Apatelodidae).

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CONTENTS

Taxonomic revision of the genera *Tamphana* Schaus and *Tuyvae* Orlandin, Piovesan & Carneiro with description of eleven new species (Lepidoptera, Apatelodidae).

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Illustration de la couverture :

Tamphana lojanara Schaus, 1929. Ecuador Oriente, Napo, Wild Sumaco Lodge, 1661 m. Photo prise par C. & T. Van Loon.

Crédits:

D. Herbin : Fig. 1-12, 14-16, 19-20, 22, 26-27, 29-30, 33-37, 40, 42, 45-46.
A. Giusti : Fig. 13, 18, 23-25, 28, 38-39, 41, 43.
C. & T. Van Loon : Fig. 17 & couverture.
L. & J. Harrison : Fig. 21.
C. Mielke : Fig. 31, 32.

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